SOIL SURVEY

Pahranagat-Penoyer Areas Nevada

OUR SOIL ★ OUR STRENGTH

Issued April 1968

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
THE UNIVERSITY OF NEVADA AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1958–63. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1963. This survey was made cooperatively by the Soil Conservation Service and the University of Nevada Agricultural Experiment Station. It is a part of the technical assistance furnished to the Pahranagat Valley Soil Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of the Pahranagat-Penoyer Areas, Nev., contains information that can be applied in managing farms, ranches, and rangeland; in selecting sites for roads, ponds, buildings or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All of the soils of the Pahranagat-Penoyer Areas are shown on the detailed map at the back of this survey. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all of the soils of the Areas in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit or units in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the discussions of the capability units and wildlife sites.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the subsection "Managing Soils for Wildlife."

Ranchers and others interested in range can find, under "Descriptions of the Soils," listings of plants that are most important in grazing areas managed for cattle.

Engineers and builders will find under "Engineering Uses of Soils" tables that give engineering descriptions of the soils in the Areas and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation and Classification of Soils."

Students, teachers, and others will find information about soils and their management in various parts of the text.

Newcomers in the Pahranagat Valley or the Penoyer Valley may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the Areas," which gives additional information about the Pahranagat-Penoyer Areas.

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Contents

NOTICE TO LIBRARIANS
Series year and series number are no longer shown on soil surveys. See explanation on the next page.

Issued April 1968

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N.J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF THE PAHRANAGAT-PENOYER AREAS, NEVADA

BY LLOYD ROOKE, L. N. LANGAN, AND D. G. BAGLEY, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF NEVADA AGRICULTURAL EXPERIMENT STATION

THE PAHRANAGAT–PENOYER AREAS are in the south-central and the western parts of Lincoln County in southern Nevada (fig. 1). The Pahranagat Area occupies 62,944 acres, and the Penoyer Area covers 212,740 acres.

These Areas have a semiarid, continental climate. Annual precipitation is low, sunshine is abundant, the rate of evaporation is high, and the air is dry and clear.

Farming and livestock raising are the main enterprises. Most of the acreage is in range that provides only limited grazing for livestock, but about 6,100 acres are used for irrigated crops, principally alfalfa, small grain, row crops, and native meadow for hay or pasture.

In the Pahranagat Area the soils used for irrigated crops are on the low-lying flood plain. These soils generally are very deep, well drained to poorly drained, and medium textured or moderately fine textured. They are suited to various kinds of crops, depending on the degree of wetness and the content of soluble salts. Row crops and seed crops can be grown in fields where soil salinity is low and where the water table is kept at a safe level.

Other soils on the flood plain in the Pahranagat Area, as well as soils adjacent to the valley floor in the Penoyer Area, generally are very deep, well drained or somewhat excessively drained, and medium textured or moderately coarse textured. These soils are used only for limited grazing, but they could be prepared for irrigation and cultivated if water were made available.

On the uplands in both Areas, some of the soils are shallow, moderately coarse textured or medium textured, and gravelly, cobbly, or stony. Others are very deep, coarse textured, and gravelly or cobbly and stony. All of these soils have a sparse cover of desert plants that provide only limited grazing. The soils are not suitable for cultivation, and they receive so little rainfall that they cannot be revegetated by using any of the methods now known.

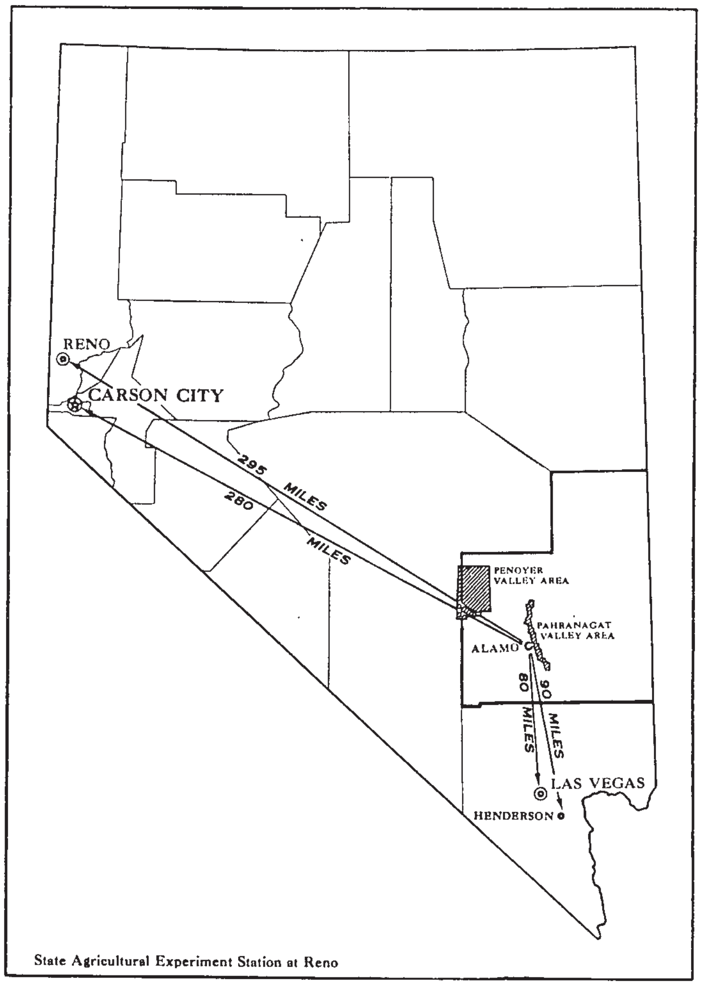

Figure 1.—**Location of the Pahranagat-Penoyer Areas in Nevada.**

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in the Pahranagat-Penoyer Areas, where they are located, and how they can be used.

They went into the Areas knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over each Area, they observed steepness, length, and shape of slopes; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in areas nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this survey efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Ash Springs and Penoyer, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in these characteristics that go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Ash Springs silt loam and Ash Springs fine sandy loam are two soil types in the Ash Springs series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Maynard Lake loamy sand, 0 to 4 percent slopes, is one of two phases of Maynard Lake loamy sand, a soil type that ranges from nearly level to strongly sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show roads, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map in the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intermingled, and so small in size that it is not practical to show them separately on the map. Therefore, they show these intermingled soils as one mapping unit and call them a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Pahranagat-Ash Springs complex.

Some mapping units contain more than one kind of soil in a pattern more open and less intricate than that of a soil complex. Such a mapping unit is called a soil association. A soil association differs from a soil complex in that its component soils can be mapped separately, at an ordinary scale such as 4 inches per mile, if practical advantages make the effort worthwhile. Separate mapping at an ordinary scale is not possible for a soil complex. A soil association, like a soil complex, is named for the major soils in it, for example, Koyen-Tickapoo association, 2 to 4 percent slopes.

Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Rock land or Clay dune land, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for the irrigated soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil surveys. On basis of the yield and practice tables and other data, the soil scientists set up trial groups, and then test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil maps at the back of this survey show, in color, the soil associations in the Pahranagat Area and the Penoyer Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

Figure 2.—**Aerial view of the Pahranagat Area, looking southward across the hamlet of Alamo, the only settlement in the Pahranagat-Penoyer Areas. The Ash Springs-Pahranagat association lies on the flood plain in the old river channel of the Pahranagat Valley. The Alko-Pahroc association is on the dry terraces adjoining the flood plain.**

Discussed in the following subsections are the six soil associations in the Pahranagat Area and the seven soil associations in the Penoyer Area.

Pahranagat Area

The Pahranagat Area is 44 miles long and roughly 2¼ miles wide. It consists of the Pahranagat Valley, which is part of an ancient, well-preserved river course and generally is ¼ to ½ mile wide, together with the adjacent terraces and rocky land on both sides. The elevation of the flood plain along the old river channel ranges from 3,900 feet at the northern end of the survey area to about 3,000 feet at the southern end. In places the nearby terraces and rocky land rise to an elevation of 5,000 feet. That part of the flood plain between Hiko Spring and Maynard Lake has been strongly modified by a series of springs. Above and below that area, however, there is no evidence of wetness.

1. Alko-Pahroc association

Nearly level to moderately sloping, gravelly soils that are shallow over silica and lime cemented hardpan; on old alluvial fans

This soil association occupies nearly level to moderately sloping old alluvial fans that extend from the Pahranagat Valley flood plain upward toward the mountains (fig. 2). The elevation ranges from about 3,000 to 5,000 feet. More than half of the Pahranagat Area is in this association.

The most extensive soils in this association are the Alko and Pahroc, but Crystal Springs soils are also important.

The Alko soils occur south of Hiko Spring, where the alluvium was derived from volcanic rocks. Most of the plant cover on Alko soils is creosotebush, white bur-sage, and Joshua-tree. The Pahroc soils, which lie northwest of Crystal Springs (also called Crystal Spring), formed in alluvium derived from both sedimentary and volcanic rocks. They are covered with almost pure stands of blackbrush. The Crystal Springs soils occupy old fans at the foot of the Alamo and Hiko Ranges. Here, the alluvium came chiefly from dolomitic limestone. The common vegetation on Crystal Springs soils is shadscale, bud sagebrush, Mormon-tea, and big galleta.

The soils in this association all are shallow and moderately coarse textured or very gravelly and medium textured; they overlie a silica- and lime-cemented hardpan. Their drainage is good, but their available water capacity is very low.

The soils are used mostly as range that provides limited grazing for livestock. Because the annual rainfall is low, there is little chance that the plant cover can be improved.

2. Pintwater-Theriot association

Sloping to very steep, shallow, rocky or extremely rocky soils on hills, ridges, and mountains

This soil association occupies sloping to very steep sides of hills, ridges, and mountains. Barren rock crops out in many places. The elevation ranges from about 3,000 to 5,000 feet. About 20 percent of the Pahranagat Area is in the association.

Dominant are the Pintwater and Theriot soils. The major acreage of the Pintwater soils lies south of Upper Pahranagat Lake, but the Theriot soils are mostly in the northern part of the association. Theriot soils occur on the east side of the old river channel, where the Alamo and Hiko Ranges extend into the Area at several locations.

The Pintwater soils are over volcanic bedrock and are shallow, very stony, and moderately coarse textured. The Theriot soils are over dolomitic limestone and are shallow, very stony, and medium textured. These soils are well drained or somewhat excessively drained and have very low available water capacity. The vegetation consists mainly of shadscale, white bur-sage, and Mormon-tea growing in sparse stands.

The soils in this association are used for limited grazing by livestock. They produce only a small amount of forage.

3. Carrizo-Maynard Lake association

Nearly level to strongly sloping, very deep, sandy soils that are gravelly or stony; on small recent alluvial fans and in intermittent stream channels

This soil association occurs throughout the Pahranagat Valley on recent alluvium in the channels of intermittent streams and in many small fans. The elevation ranges from about 2,300 to 4,100 feet. Slopes are nearly level to strong. The association makes up about 12 percent of the Pahranagat Area.

The Carrizo and Maynard Lake soils are dominant in the association, but the Seaman soils are also important. All these soils formed in alluvium derived from both sedimentary and volcanic rocks. The Carrizo soils are coarse textured, very gravelly and cobbly, very rapidly permeable, and excessively drained. The Maynard Lake soils are coarse textured and are stratified with layers of gravelly, coarse-textured material. They are rapidly permeable and somewhat excessively drained. The nearly level and gently sloping Seaman soils are moderately coarse textured, have moderately rapid permeability, and are well drained.

In most areas the soils of this association are covered with a sparse stand of creosotebush, white bur-sage, and yucca. In places, however, the vegetation is greasewood, rubber rabbitbrush, and saltgrass. These plants occur where the parent alluvium was deposited on an area of the old river channel that had restricted drainage and contained an accumulation of salts.

Most of the acreage in this association is in range that provides little forage for livestock. The Carrizo soils generally are not suitable for cultivation, but crops are grown on about 5 percent of the Maynard Lake soils and about 30 percent of the Seaman soils. The Maynard Lake and Seaman soils are not wholly suitable for cropping, because they occupy such small areas that satisfactory irrigation is difficult. In places where salts have accumulated, the soils can be improved by draining and leaching.

The Seaman and Maynard Lake soils can be used for some kinds of deciduous orchards if adequate water is available for irrigation.

4. Geer-Penoyer association

Flat or nearly level, very deep, medium-textured soils on flood plains

This soil association occupies flat or nearly level parts of the Pahranagat Valley flood plain that are usually dry. Although they account for less than 5 percent of the total acreage, these areas extend all the way from Maynard Lake to the northern boundary and beyond. The elevation ranges from about 3,000 to 3,900 feet.

Dominant in the association are the Geer and Penoyer soils, all of which have a medium-textured subsoil. The Geer soils are very deep, loamy, moderately permeable, and chiefly moderately well drained. In some areas they are somewhat poorly drained and are affected by salts brought upward into the root zone by canal seepage and spring water. The Penoyer soils are very deep and silty, have slow or moderately slow permeability, and are well drained.

Most of the acreage in this association is in range that provides forage for livestock and habitat for wildlife. Fourwing saltbush, quailbush, and greasewood are the principal plants. The cultivated areas are used mainly for some kinds of row crops and other field crops that are suited to the Pahranagat Area. Except in places strongly affected by salts, the saline Geer soils are potentially just as productive as the nonsaline ones. They can be reclaimed by lowering the water table and then leaching the excess salts.

5. Ash Springs-Pahranagat association

Nearly level soils that have a fluctuating water table; on flood plains

This soil association is in nearly level areas of the Pahranagat Valley flood plain that have a high water table caused by springs that feed the ground water (fig. 3). It lies between Maynard Lake and Hiko Spring at

Figure 3.—A thermal spring, emerging at the base of a dolomite hill, in the Ash Springs-Pahranagat association. The ledgelike rock (right center) is travertine that was formed by spring water in the past. On the hillside beyond are Theriot soils.

elevations ranging from 3,000 to 3,900 feet. About 8 percent of the survey area is in this association.

Dominant are the Ash Springs and Pahranagat soils, but also important are Peat, a miscellaneous land type, and the Lahontan soils. The Ash Springs soils are very deep and consist of medium-textured soil material stratified with moderately coarse textured material. They have moderately slow permeability, are somewhat poorly drained or poorly drained, and are affected by soluble salts. The Pahranagat soils are very deep, silty but erratically stratified soils consisting of medium-textured to fine-textured mineral material in which there are a few thin layers of muck or mucklike material. They have moderately slow permeability and are poorly drained or somewhat poorly drained.

The vegetation on these soils consists mostly of native meadow plants, such as sedges, rushes, clover, inland saltgrass, and alkali sacaton. In general, the fluctuating water table is highest in winter and spring, but the height of the water table, as well as the content of salts and alkali, varies considerably from place to place. A few small areas of Peat and of Lahontan soils, water table variants, have a nonfluctuating water table, and a few areas of the Lahontan variants are gently sloping.

Meadow hay and pasture are produced in most areas of this association, though row crops or other field crops are grown in drained areas. Unless drainage is improved, reclaiming the soils is not feasible (fig. 4). Draining areas of Peat is not advisable, however, for it would cause drying and excessive shrinking and cracking.

Figure 4.—A waterlogged area on the nearly level flood plain, Ash Springs-Pahranagat association. A giant cottonwood has been uprooted, and its shallow roots are exposed.

6. Adaven-Bastian association

Nearly level, medium-textured, saline-alkali soils on small alluvial fans and along lake and channel margins

This soil association is on small alluvial fans and along the margins of lakes and channels. It occurs in many, small or narrow, nearly level areas. Except in an area south of Hiko Lake, the association adjoins the Ash Springs-Pahranagat association. It is affected by ground water and is covered mostly with inland saltgrass. It makes up less than 2 percent of the Pahranagat Area.

The Adaven and Bastian soils, the principal soils, are somewhat poorly drained and are affected by salts and alkali. Adaven soils are stratified, moderately coarse textured and medium textured, and moderately deep over a hardpan strongly cemented with lime. Bastian soils are medium textured and contain weak silica cementation in their subsoil.

These soils are used mainly for livestock grazing and as habitat for small game. The amount of forage produced is limited by the excess salts and alkali. If the Bastian soils are drained, they can be reclaimed and cultivated. In places the Adaven soils can be developed for improved pasture consisting of salt-tolerant plants.

Penoyer Area

The Penoyer Area consists mainly of the Penoyer Valley, a large basin extending in a north-northeast and south-southwest direction. Included in the total acreage, mostly along the western boundary, are parts of the rocky rim above the basin. Livestock grazing is the dominant use of soils in the Area. None of the acreage has been developed as cropland, but development can be expected in the near future because wells have been installed for irrigation.

1. Playa-Jarboe-Kawich association

Flat wasteland; nearly level, fine-textured, saline and alkali soils; and coarse-textured soils on dunes

This soil association occupies the lowest part of the Penoyer basin and is nearly level, except in places where the wind has formed dunes. The elevation ranges from 4,750 to 4,900 feet. The association makes up about 8 percent of the Penoyer Area.

The land type Playa—the level bed of an intermittent lake—is most extensive in this association. The soil material in this lakebed is very hard, very pale brown or light yellowish brown and barren (fig. 5). Next most extensive, and adjoining the Playa at a slightly higher elevation, are the Jarboe soils. These soils are moderately fine textured, have very slow permeability, are strongly affected by salts and alkali, and are shallow to a lime-cemented hardpan. The Kawich soils consist of windblown sand in semistabilized dunes on the surface of the playa. These dunes are generally 4 to 15 feet high and are 10 to 75 feet across. North of Sand Spring, however, they are less than 4 feet high. The Kawich soils are rapidly permeable and are less saline-alkali than the Jarboe soils.

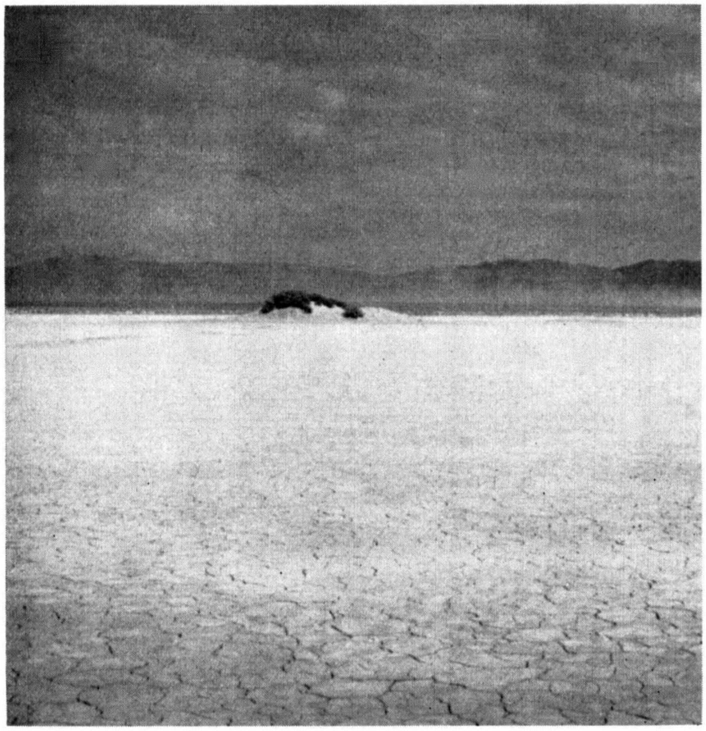

Figure 5.—**The sun-baked Playa that makes up the lowest part of the Penoyer basin, Playa-Jarboe-Kawich association. In the background is a clay dune covered with a few greasewood plants.**

Greasewood dominates in the plant cover on Jarboe and Kawich soils, and there is some shadscale, fourwing saltbush, and graymolly, but about 95 percent of the soil surface is barren.

On the northeastern shore of the main playa is an area of the land type Clay dune land in which the material is stratified, pinkish gray, and strongly affected by salts and alkali. Only a few greasewood plants grow on the clay dunes. At Sand Spring there is a large mound consisting of the land type Tufa rock land intermingled with the Kawich soils. A small area of the land type Slickens occurs below the Lincoln mine.

Little or no use is made of the soils in this association. Ground water of good quality is near the surface, but it is doubtful if the soils could be reclaimed. External drainage is lacking, and internal drainage is slow. If the soils are used, soil blowing and occasional flooding are hazards.

2. *Monte Cristo-Penoyer association*

Nearly level saline-alkali soils

This soil association adjoins the Playa-Jarboe-Kawich association in areas that are slightly higher than the bottom of the Penoyer basin. It occupies nearly level areas on toe slopes of large, merging alluvial fans and on flood plains. The elevation ranges from about 4,850 to 5,050 feet. The dominant plants are graymolly, shadscale, fourwing saltbush, bud sagebrush, and greasewood. Less than 10 percent of the Penoyer Area is in this association.

The Monte Cristo and Penoyer soils make up most of the association, but the Puddle, McCutchen, Timper, Belted, and Woodrow soils also are important. The Monte Cristo soils are moderately fine textured, are affected by salts and alkali, and, at a depth of 15 to 24 inches, have a hardpan strongly cemented with silica. Although the Monte Cristo soils are now well drained, their mottled substratum indicates that they likely had restricted drainage while they were developing. The Penoyer soils are very deep, well drained, and silty. They are slow or moderately slow in permeability and are affected by salts and alkali.

The soils in this association are used for livestock grazing, but the amount of forage produced is small. Much of the acreage is not suitable for crops, because the root zone is thin and permeability is very slow. The Penoyer, Puddle, and Woodrow soils can be reclaimed and irrigated if water is available, but the availability of sufficient ground water for irrigation is uncertain, particularly in areas of these soils north of Sand Spring.

3. *Fang-Cliffdown association*

Nearly level and gently sloping, moderately coarse textured and coarse textured soils on alluvial fans and flood plains

This soil association occupies nearly level and gently sloping alluvial fans and flood plains. It lies in an area that is somewhat ring-shaped around the basin and accounts for about 30 percent of the Penoyer Area. The dominant plants are galleta, winterfat, bud sagebrush, and fourwing saltbush. Elevations range from 4,800 to 5,600 feet.

The Fang and Cliffdown soils dominate in the association, but the Sundown, Leo, Koyen, Bluewing, Stumble, and Aysees soils are important also. The Fang soils formed in alluvium derived from volcanic rocks. They are moderately coarse textured throughout and are moderately permeable. The Cliffdown soils formed in alluvium from sedimentary rocks. They are gravelly, are moderately coarse textured, and have moderately rapid permeability.

The soils in this association are in range that is used mostly for grazing by livestock. Irrigating these soils would be feasible if water were made available.

4. *Papoose-Nyala association*

Nearly level and gently sloping soils that have a loamy subsoil; on alluvial fans

This soil association is on nearly level and gently sloping alluvial fans, mainly in the south half of the basin, at elevations of about 4,800 to 5,100 feet. The vegetation is sparse and consists chiefly of fourwing saltbush, bud sagebrush, galleta, and winterfat. About 5 percent of the Penoyer Area is in this association.

The Papoose and Nyala soils are dominant in this association, but the Tippipah soils also occur. All these soils are very deep, are well drained, and have moderate or moderately slow permeability. The Papoose soils have a light sandy clay loam subsoil; they formed in material derived mainly from volcanic rocks. The Nyala soils occur with the Fang soils in the mideastern part of the basin. They formed in material that came mostly from volcanic rocks but was influenced by sedimentary rocks. Nyala soils have a sandy clay loam subsoil. The Tippipah soils occupy a single area south of State Route 25, where they formed in alluvium from volcanic rocks. Unlike the

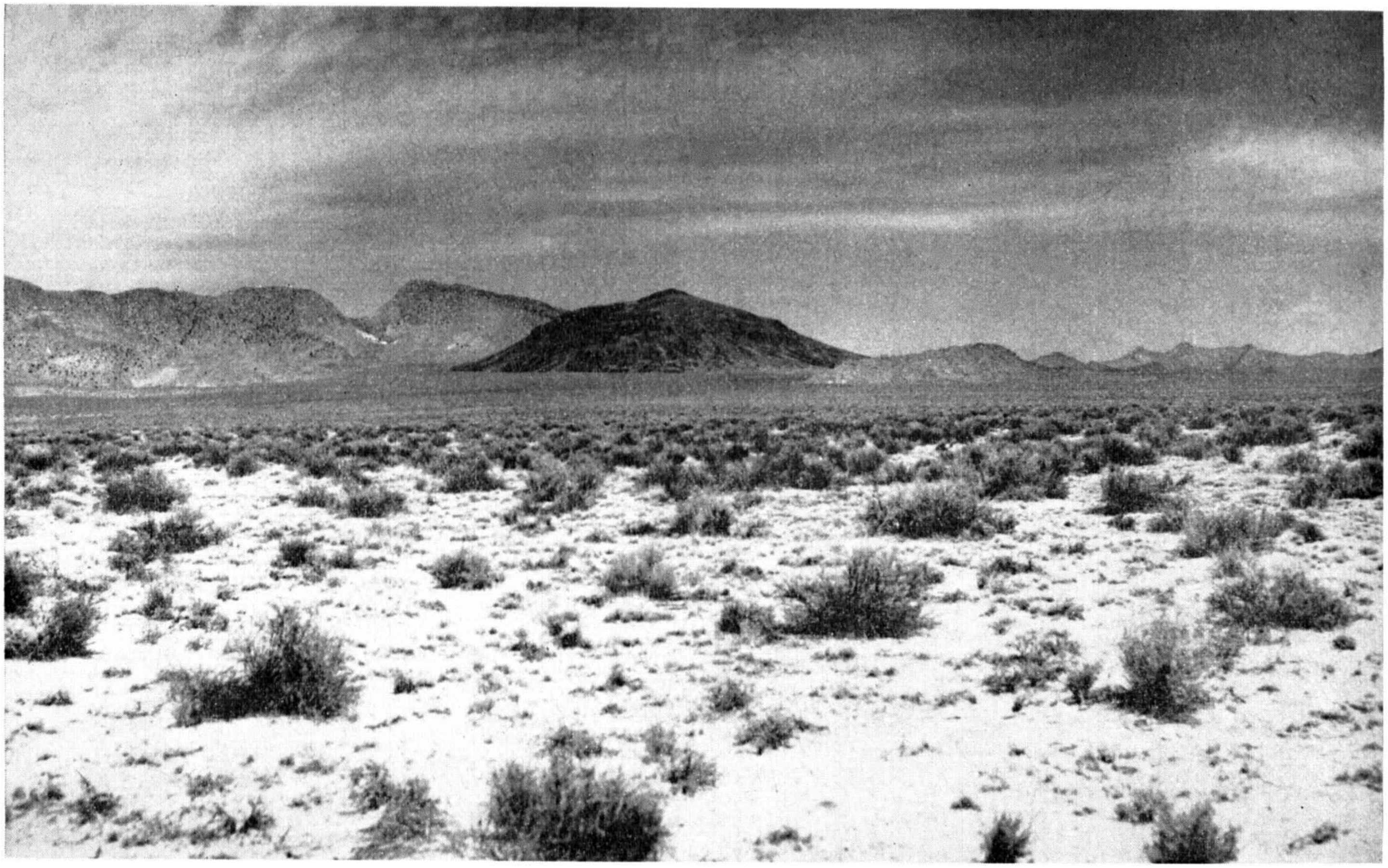

Figure 6.—**Landscape of Tickapoo soils in the Tickapoo-Timpahute association. In the background is the southwestern rocky rim of the Penoyer basin. Dark-colored mountain in background consists of andesite.**

other soils in the association, the Tippipah soils contain an accumulation of sodium in the subsoil.

The soils in this association are used mostly as range for livestock. If they were irrigated, they could be used for diversified crops that are suited to the Area.

5. *Tickapoo-Timpahute association*

Nearly level to strongly sloping soils that have a clayey subsoil

This soil association occupies nearly level to strongly sloping old alluvial fans that consist of material from weathered volcanic rocks. It lies below and adjacent to mountains in the western half of the basin, at elevations between 4,900 and 5,800 feet (fig. 6). The surface is slightly undulating because of many old channels that were formed under a climate differing from that of today. Winterfat and galleta are the principal plants at lower elevations, and Mormon-tea, bud sagebrush, spiny hopsage, and galleta are the main ones at higher elevations. About 20 percent of the Penoyer Area is in this association.

The Tickapoo and Timpahute soils are the major soils, but the Alko, Specter, and Leo soils also are important. Tickapoo soils are deep, are fine textured, and contain horizons that are weakly or strongly cemented with silica. Timpahute soils are moderately deep, are fine textured, and have a silica-lime indurated hardpan. The soils of both series developed in alluvium derived from ignimbrite, a silicic volcanic rock.

The soils in this association are in range that provides grazing for cattle. The higher areas are likely to remain in range, but the lower areas can be developed as irrigated cropland if water is made available.

6. *Silent-Sierocliff association*

Gently sloping to strongly sloping, moderately deep and shallow, limy soils

This soil association occurs on gently sloping to strongly sloping old alluvial fans that consists of material derived mainly from sedimentary rocks. It lies below and adjacent to mountains in the eastern half of the basin, at elevations of 4,900 to about 6,000 feet. The surface is broken into undulating relief by many old channels that were formed in the distant past when the climate differed from that of today. The dominant vegetation is galleta, shadscale, black sagebrush, and bud sagebrush. About 15 percent of the Penoyer Area is in this association.

Dominant in this association are the Silent and Sierocliff soils, but the Crystal Springs soils are also important. Silent soils, which occur in the southwestern part, are moderately fine textured and are shallow over a lime-indurated hardpan. Sierocliff soils, mostly in the northeastern part, are very gravelly, medium textured or mod-

erately coarse textured, and moderately deep over a lime-indurated hardpan. The soils of both series developed in alluvium derived mainly from limestone.

The soils in this association are used as range for cattle.

7. *Rock land-Silverbow association*

Moderately sloping to extremely steep rocky areas and shallow soils

This soil association occupies parts of the rocky rim above the Penoyer basin, chiefly along the western side of the survey area. Here, the elevation ranges from about 5,300 to 6,000 feet. Slopes are moderate to extremely steep. The vegetation is sparse and consists mainly of such desert shrubs as Anderson wolfberry, Mormon-tea, and spiny hopsage, but galleta and Indian ricegrass also occur in the plant cover. The association accounts for about 15 percent of the Penoyer Area.

Rock land, a miscellaneous land type, and Silverbow soils make up the major part of the association, but the Tolicha and Nevoyer soils also are important. Rock land, which covers about two-thirds of the total acreage, consists of large barren outcrops of ignimbrite and areas of very shallow soils that support only a very sparse cover of plants. The Silverbow soils are very stony, moderately fine textured, and shallow over an indurated, very stony hardpan. These soils developed on the colluvial slopes of low-lying andesitic foothills. The Tolicha and Nevoyer soils are shallow or very shallow, gravelly or stony, loamy soils that developed in residual material from volcanic rocks.

The shrubs and grasses on all these soils provide limited grazing.

Descriptions of the Soils

This section describes the soil series and mapping units of the Pahranagat-Penoyer Areas. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is first to describe the soil series, and then the mapping units in that series. For each soil series, a profile of a soil representative of the series is described. Thus, to get full information on any one mapping unit, it is necessary to read the description of the soil series to which it belongs.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Rock land, for example, does not belong to a soil series, but, nevertheless, is listed in alphabetical order along with the soil series.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed. The page on which each capability unit is described can be found by referring to the "Guide to Mapping Units" at the back of the soil survey.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Map symbol	Soil or land type	Area	Extent	Map symbol	Soil or land type	Area	Extent
		Acres	*Percent*			*Acres*	*Percent*
Ad	Adaven loam	507	0. 2	CaC	Carrizo gravelly sand, 0 to 12 percent slopes.	1, 375	0. 5
AkB	Alko loamy coarse sand, 0 to 8 percent slopes.	18, 652	6. 8	CbC	Carrizo stony loamy sand, 0 to 12 percent slopes.	2, 374	. 9
AlB	Alko stony loamy coarse sand, 0 to 8 percent slopes.	5, 881	2. 1	Cd	Clay dune land-Playa association	1, 050	. 4
AmB	Alko-Tickapoo-Rock land association, 2 to 8 percent slopes.	4, 585	1. 7	CfA	Cliffdown gravelly sandy loam, 0 to 2 percent slopes.	3, 000	1. 1
An	Ash Springs fine sandy loam, somewhat poorly drained.	49	(1)	CfB2	Cliffdown gravelly sandy loam, 2 to 4 percent slopes, eroded.	6, 150	2. 2
Ao	Ash Springs silt loam	429	. 2	ChA	Cliffdown loamy sand, 0 to 2 percent slopes.	270	. 1
Ap	Ash Springs silt loam, somewhat poorly drained.	99	(1)	CkB	Cliffdown sandy loam, 2 to 4 percent slopes.	625	. 2
Ar	Ash Springs silt loam, reclaimed	159	. 1				
As	Ash Springs silty clay loam	103	(1)	ClB2	Cliffdown very gravelly sandy loam, 2 to 4 percent slopes, eroded.	3, 625	1. 3
At	Ash Springs silt loam, heavy subsoil variant, somewhat poorly drained.	98	(1)	CmC	Crystal Springs cobbly fine sandy loam, 2 to 8 percent slopes.	3, 717	1. 3
Au	Ash Springs silt loam, heavy subsoil variant, slightly saline.	256	. 1	CnB	Crystal Springs gravelly loam, 2 to 4 percent slopes.	1, 215	. 4
Av	Ash Springs silty clay loam, heavy subsoil variant, slightly saline.	81	(1)	CsB	Crystal Springs-Cliffdown association, 2 to 4 percent slopes.	1, 510	. 5
AyA	Aysees gravelly sandy loam, 0 to 2 percent slopes.	1, 670	. 6	FaA	Fang fine sandy loam, 0 to 2 percent slopes.	4, 070	1. 5
AyB	Aysees gravelly sandy loam, 2 to 4 percent slopes.	575	. 2	FaB	Fang fine sandy loam, 2 to 4 percent slopes.	790	. 3
Ba	Bastian fine sandy loam, strongly saline.	122	(1)	FgA	Fang gravelly fine sandy loam, overflow, 0 to 2 percent slopes.	2, 035	. 7
Bc	Bastian silt loam, moderately saline	165	. 1				
Bd	Bastian silt loam, strongly saline	190	. 1	FhB	Fang gravelly sandy loam, 2 to 4 percent slopes.	830	. 3
Bs	Belted sandy loam	710	. 3				
BuC	Bluewing very gravelly loamy sand, 2 to 12 percent slopes.	3, 155	1. 1	FlA	Fang loamy fine sand, 0 to 2 percent slopes.	750	. 3

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Map symbol	Soil or land type	Area	Extent	Map symbol	Soil or land type	Area	Extent
		Acres	*Percent*			*Acres*	*Percent*
FmA	Fang loamy fine sand, overblown, 0 to 2 percent slopes.	820	0. 3	PmA	Papoose loamy fine sand, 0 to 2 percent slopes.	4, 680	1. 7
FnA	Fang sandy loam, 0 to 2 percent slopes.	12, 395	4. 5	PnA	Papoose sandy loam, 0 to 2 percent slopes.	1, 880	. 7
FpA	Fang sandy loam, slightly saline-alkali, 0 to 2 percent slopes.	90	(1)	PnA2	Papoose sandy loam, 0 to 2 percent slopes, eroded.	870	. 3
FrB	Fang sandy loam, deep, 2 to 4 percent slopes.	2, 395	. 9	PnB	Papoose sandy loam, 2 to 4 percent slopes.	3, 630	1. 3
FsB	Fang-Nyala association, 2 to 4 percent slopes.	6, 590	2. 4	PoA	Papoose sandy loam, slightly saline, 0 to 2 percent slopes.	1, 285	. 5
Ge	Geer fine sandy loam	580	. 2	Pp	Peat	230	. 1
Gf	Geer fine sandy loam, slightly saline	329	. 1	Pr	Penoyer loam, moderately saline-alkali.	1, 140	. 4
Gh	Geer fine sandy loam, water table, strongly saline.	355	. 1	Ps	Penoyer loam, slightly saline-alkali	1, 130	. 4
Gk	Geer silt loam	123	(1)	Pt	Penoyer silt loam	565	. 2
Gl	Geer silt loam, water table	105	(1)	Pu	Penoyer silt loam, slightly saline-alkali.	1, 720	. 6
Gm	Geer silt loam, water table, moderately saline.	130	(1)	PvE	Pintwater rocky sandy loam, 12 to 45 percent slopes.	10, 095	3. 7
Gn	Geer silt loam, water table, slightly saline.	120	(1)	Pw	Puddle fine sandy loam	1, 490	. 5
Ja	Jarboe sandy loam, saline-alkali	3, 000	1. 1	Rl	Rock land	14, 341	5. 2
Jb	Jarboe very fine sandy loam, strongly saline-alkali.	1, 670	. 6	SaA	Seaman fine sandy loam, hummocky, 0 to 2 percent slopes.	132	(1)
Kp	Kawich-Playa complex	11, 570	4. 2	SbA	Seaman loamy fine sand, 0 to 2 percent slopes.	122	(1)
KsB	Koyen sandy loam, 2 to 4 percent slopes.	3, 280	1. 2	ScA	Seaman sandy loam, 0 to 2 percent slopes.	1, 088	. 4
KtB	Koyen-Tickapoo association, 2 to 4 percent slopes.	440	. 2	ScB	Seaman sandy loam, 2 to 4 percent slopes.	355	. 1
LaA	Lahontan fine sandy loam, water table variant, 0 to 2 percent slopes.	40	(1)	SdA	Seaman sandy loam, water table, slightly saline, 0 to 2 percent slopes.	329	. 1
LaB	Lahontan fine sandy loam, water table variant, 2 to 4 percent slopes.	52	(1)	SeA	Seaman sandy loam, water table, strongly saline, 0 to 2 percent slopes.	74	(1)
LhA	Lahontan silt loam, water table variant, 0 to 2 percent slopes.	197	. 1	SfC	Sierocliff extremely stony very fine sandy loam, 4 to 12 percent slopes.	7, 255	2. 6
LhB	Lahontan silt loam, water table variant, 2 to 4 percent slopes.	62	(1)	SgC	Silent gravelly loam, 2 to 12 percent slopes.	5, 450	2. 0
LmA	Lahontan silt loam, water table variant, moderately saline, 0 to 2 percent slopes.	164	. 1	ShB	Silent gravelly sandy loam, 2 to 4 percent slopes.	820	. 3
Ln	Lahontan silty clay, poorly drained variant.	134	(1)	SkD	Silent very rocky loam, 4 to 12 percent slopes.	3, 820	1. 4
LrC	Leo extremely rocky sandy loam, 2 to 12 percent slopes.	455	. 2	SlD	Silverbow extremely stony very fine sandy loam, 8 to 12 percent slopes.	3, 055	1. 1
LsC	Leo gravelly sandy loam, 2 to 12 percent slopes.	4, 720	1. 7	Sm	Slickens	150	. 1
MkC	Maynard Lake gravelly soils, 4 to 12 percent slopes.	2, 340	. 8	SnC2	Specter gravelly loam, 2 to 12 percent slopes, eroded.	665	. 2
MlB	Maynard Lake loamy sand, 0 to 4 percent slopes.	100	(1)	St	Stumble loamy sand	2, 740	1. 0
MlC	Maynard Lake loamy sand, 4 to 12 percent slopes.	288	. 1	Su	Stumble loamy sand, deep	250	. 1
Mn	McCutchen loam	1, 990	. 7	SvA2	Sundown loamy sand, 0 to 2 percent slopes, eroded.	730	. 3
Mr	Monte Cristo fine sandy loam	8, 985	3. 2	SwA	Sundown sandy loam, 0 to 2 percent slopes.	5, 120	1. 9
NeD	Nevoyer gravelly loam, 4 to 12 percent slopes.	1, 895	. 7	SyB2	Sundown very gravelly loamy sand, 2 to 4 percent slopes, eroded.	2, 605	. 9
Pa	Pahranagat silt loam	264	. 1	TaF	Theriot extremely rocky loam, 30 to 100 percent slopes.	1, 702	. 6
Pb	Pahranagat silt loam, drained	228	. 1	TcA	Tickapoo gravelly fine sandy loam, 0 to 2 percent slopes.	500	. 2
Pc	Pahranagat silt loam, drained, slightly saline.	310	. 1	TdB	Tickapoo gravelly sandy loam, 2 to 4 percent slopes.	20, 075	7. 3
Pd	Pahranagat silt loam, slightly saline	303	. 1	TdB2	Tickapoo gravelly sandy loam, 2 to 4 percent slopes, eroded.	2, 830	1. 0
Pe	Pahranagat-Ash Springs complex	382	. 1	TkB	Tickapoo sandy loam, 2 to 4 percent slopes.	6, 235	2. 3
Pg	Pahranagat-Ash Springs complex, seeped.	455	. 2	TlC	Tickapoo-Leo association, 4 to 12 percent slopes.	10, 620	3. 8
Ph	Pahranagat-Ash Springs variant complex.	95	(1)				
Pk	Pahranagat-Ash Springs variant complex, drained.	362	. 1				
PlC	Pahroc gravelly loam, 2 to 8 percent slopes.	5, 427	2. 0				

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Map symbol	Soil or land type	Area	Extent	Map symbol	Soil or land type	Area	Extent
		Acres	*Percent*			*Acres*	*Percent*
TmC	Timpahute very stony clay loam, 2 to 12 percent slopes.	2, 715	1. 0	TuD	Tufa rock land-Kawich association, 0 to 12 percent slopes.	370	0. 1
TnC	Timpahute-Leo association, 2 to 12 percent slopes.	2, 895	1. 0	Wc	Woodrow clay loam	300	. 1
Tp	Timper sandy loam	770	. 3		Lakes	1, 039	. 4
Tr	Tippipah sandy loam	995	. 4		Total	275, 684	100. 0
TsD	Tolicha extremely stony very fine sandy loam, 4 to 12 percent slopes.	2, 710	1. 0				

[1] Less than 0.05 percent.

Unless otherwise stated, the profile of the representative soil described has been located in an undisturbed area. The color of each soil horizon is described in words, such as light brownish gray, but it can also be indicated by symbols for the hue, value, and chroma, such as 10YR 6/2. These symbols, called Munsell color notations (*11*),[1] are used by soil scientists to evaluate the color of the soil precisely. Unless noted otherwise, the pH was determined by using soil and water in a ratio of 1:5.

Many terms used in the soil descriptions and other sections of the survey are defined in the Glossary.

Adaven Series

In the Adaven series are stratified, moderately coarse textured and medium-textured soils that are strongly affected by salts and alkali. These soils developed in alluvium derived from several kinds of rocks. They have been modified by the evaporation of water from hot springs having a high content of lime, and they contain a hardpan strongly cemented with lime. Adaven soils occupy small, nearly level alluvial fans that merge with the wet flood plain in Pahranagat Valley.

Representative profile of an Adaven soil, located in the north half of section 27, T. 7 S., R. 61 E. (laboratory data for this soil are given in tables 9 and 10):

A1—0 to 2 inches, light-gray (10YR 7/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; massive; soft when dry, very friable when moist, sticky and plastic when wet; abundant fine and very fine roots; many fine and medium interstitial pores; strongly effervescent; pH 9.0; abrupt, smooth boundary.

C1—2 to 11 inches, light-gray (10YR 7/2) loam or silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium and fine, granular structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant very fine and fine roots; many very fine and fine interstitial pores; strongly effervescent; pH 9.3; abrupt, wavy boundary.

C2ca—11 to 16 inches, very pale brown (10YR 8/3) fine sandy loam, light brownish gray (10YR 6/2) when moist; few dark-brown (7.5YR 3/2) organic stains in old root channels; massive; hard when dry, friable when moist, nonsticky and nonplastic when wet; abundant fine and very fine roots and few medium roots; common very fine and fine tubular pores, and many fine and very fine interstitial pores; strongly effervescent; pH 9.3; abrupt, wavy boundary.

C3ca—16 to 24 inches, white (10YR 8/2) fine sandy loam, pale brown (10YR 6/3) when moist; weak, fine, subangular blocky structure; hard when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots, and few medium roots; common very fine and fine tubular pores, and many fine and very fine interstitial pores; strongly effervescent; few, small, hard and soft lime nodules; pH 8.9; abrupt, wavy boundary.

C4cam—24 to 39 inches, white (10YR 8/1), strongly lime-cemented hardpan (about 10 percent fine gravel), light brownish gray (10YR 6/2) when moist; a few, fine and medium, reddish-brown (5YR 4/3) iron stains along root channels; massive; plentiful very fine, fine, and medium roots along fracture planes; common, very fine and fine tubular pores that appear to be coated with lime or with lime and silica; violently effervescent; pH 8.7; clear, wavy boundary.

C5—39 to 50 inches, light-gray (2.5Y 7/2) sandy loam (10 to 14 percent fine gravel), grayish brown (2.5Y 5/2) when moist; common, fine, faint, yellowish-brown (10YR 5/4) organic stains; a few, fine, dark reddish-brown (5YR 3/2) iron mottlings; massive; hard when dry, friable when moist, nonsticky and nonplastic when wet; few very fine and fine roots; few fine and medium tubular pores, and many fine and medium interstitial pores; violently effervescent; pH 8.8; clear, wavy boundary.

C6—50 to 60 inches +, light-gray (2.5Y 7/2) sandy loam (10 to 12 percent fine gravel), grayish brown (2.5Y 5/2) when moist; common, medium, yellowish-brown (10YR 5/4) organic stains; common very fine, fine, and medium, dark reddish-brown (5YR 3/2) iron mottlings; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine and medium roots; few fine and medium tubular pores, and many fine and very fine interstitial pores; strongly effervescent; pH 8.7.

Gravel may occur in any horizon and make up as much as 20 percent of the volume. The depth to the hardpan ranges from 20 to 30 inches. In some places there are reddish or yellowish iron mottles below a depth of 20 inches. The reaction is very strongly alkaline or strongly alkaline.

These somewhat poorly drained soils have slow runoff, slow or very slow permeability, and a moderately deep root zone. The water table fluctuates between the depths of 18 and 30 inches most of the year, but it is highest in winter. The ground water is fed from hot springs or from seeps located in or adjacent to these soils. Natural fertility and the available water capacity are low, and the hazard of erosion is slight.

Adaven loam (Ad).—This soil occurs on many, small, nearly level alluvial fans along the margins of the flood

[1] Italic numbers in parentheses refer to Literature Cited, p. 120.

plain in Pahranagat Valley. The fans are adjacent to springs or seeps and to the various lakes in the valley. The vegetation consists mainly of inland saltgrass, but there is some alkali sacaton, baltic rush, fourwing saltbush, and quailbush. These plants cover about 40 percent of the soil surface.

Included with this soil are small poorly drained areas adjacent to springs. In these areas the water table is at a depth of about 12 inches throughout the year. Here, the hardpan ranges from 4 to 18 inches in depth and from 5 to 22 inches in thickness. It consists of indurated layers and strongly cemented layers. Also included are areas where the lining of irrigation ditches and the construction of deep ditches have lowered the water table to an average depth of 6 feet. In addition, there are a few small areas having slopes of 2 to 3 percent. All of these inclusions occupy about 20 percent of the total acreage.

This soil is used for irrigated pasture consisting chiefly of inland saltgrass, and it also provides habitat for wildlife. The soil is not suitable for intensive cultivation, because the water table is high and the concentration of salts and alkali is strong. The quality of forage can be improved if the application of irrigation water is controlled and if excess water is removed after irrigation. In grazing areas managed for cattle, the most important plants are alkali sacaton and inland saltgrass. (Capability unit VIw-6, irrigated)

Alko Series

The Alko series consists of moderately coarse textured soils that contain a hardpan cemented with silica and lime. These soils formed in alluvium derived mainly from ignimbrite, granodiorite, and basalt. They occupy long, broad, nearly level to moderate sloping alluvial fans along the western side of Pahranagat Valley and in the northwestern part of Penoyer Valley.

Representative profile of an Alko soil, located in an unsurveyed township, about 500 feet south and 5,000 feet west of the northwest corner of section 7, T. 7 S., R. 61 E. (laboratory data for this soil are given in tables 9 and 10):

A1—0 to 1 inch, light brownish-gray (10YR 6/2) loamy coarse sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry or moist; devoid of roots; many very fine and fine interstitial pores; strongly effervescent; pH 8.6; abrupt, smooth boundary.

C1—1 to 4 inches, light-gray (10YR 7/2) coarse sandy loam, dark grayish brown (10YR 4/2) when moist; moderate, medium and thick, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine roots; many very fine, fine, and medium vesicular pores; violently effervescent; pH 8.8; abrupt, smooth boundary.

C2—4 to 11 inches, very pale brown (10YR 7/3) coarse sandy loam, dark brown (10YR 4/3) when moist, brown (10YR 5/3) when moist and rubbed; weak, medium and fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine and fine roots; many very fine and fine interstitial pores; violently effervescent; pH 8.8; abrupt, slightly wavy boundary.

C3sicam—11 to 19 inches, white (10YR 8/1), indurated, silica-lime cemented hardpan, light gray (10YR 7/2) when moist; weak and moderate, thin, platy structure; few very fine, fine, and medium roots between plates; contains many dense laminar strata that are smooth on upper surfaces and are so strongly cemented together that they cannot be separated; violently effervescent; pH 8.8; abrupt, wavy boundary.

C4sicam—19 to 33 inches, white (10YR 8/1), indurated, silica-lime cemented hardpan, very pale brown (10YR 7/3) when moist; massive; very few, very fine and fine roots; many micro and few very fine interstitial pores; violently effervescent; pH 9.2; abrupt, smooth boundary.

IIC5ca—33 to 43 inches, light-gray (10YR 7/2) coarse sand, dark grayish brown (10YR 4/2) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine and fine roots; many very fine and fine interstitial pores; violently effervescent; much fine, white, segregated and disseminated lime that cements the material slightly when dry; pH 9.2; abrupt, wavy boundary.

IIC6—43 to 50 inches +, light brownish-gray (10YR 6/2) coarse sand (10 percent fine gravel), dark grayish brown (10YR 4/2) when moist; single grain; loose when dry or moist; very few, very fine roots; many very fine and fine interstitial pores; noncalcareous; pH 8.9.

The hardpan ranges from 10 to 20 inches in depth from the surface and from 12 to 24 inches in thickness. If the A1 horizon is mixed with some of the C1 horizon, the surface layer is loamy coarse sand or coarse sandy loam that contains coarse fragments in some places. Coarse fragments vary in size and number throughout the profile. The content of gravel and cobblestones ranges from 10 to 30 percent, and in places the content of larger stones is as much as 30 percent. The reaction is strongly alkaline or very strongly alkaline.

These soils are well drained, have slow runoff, and are very slowly permeable. Their root zone is thin, and their available water capacity and inherent fertility are very low. Erosion is a slight or moderate hazard.

The Alko soils are used to provide limited grazing for livestock. They are not suitable for intensive cultivation or for irrigation, because of their shallow root zone and very low available water capacity.

Alko loamy coarse sand, 0 to 8 percent slopes (AkB).—This soil lies along the western side of Pahranagat Valley, mostly north of Maynard Lake. It is the most extensive Alko soil in the Pahranagat Area. The main plants are shadscale, spiny menodora, Mormon-tea, Anderson wolfberry, spiny hopsage, galleta, and bush muhly.

In all parts of the profile, coarse fragments make up less than 15 percent of the volume. These fragments are mostly pebbles, but there are a few cobblestones or stones on the surface. Erosion is a slight or moderate hazard.

Included with this soil are short, steep, cobbly and gravelly terrace escarpments that occupy about 3 percent of the total acreage. Also included, in a few drainage channels, are areas of very gravelly, coarse-textured Carrizo soils that make up 5 percent of the acreage.

This soil is in range that provides limited grazing for livestock. On range managed for cattle, bush muhly and galleta are the most important plants. The airstrip at Alamo is located on this soil. (Capability unit VIIs-8, dryland)

Alko stony loamy coarse sand, 0 to 8 percent slopes (AlB).—This soil is extensive on both sides of the Pahranagat Valley, from Upper Pahranagat Lake to the southern boundary of the survey area. The vegetation consists mainly of white bur-sage, creosotebush, Joshua-tree, Mormon-tea, range ratany, and big galleta.

This soil has a profile that is similar to the one described for the series, but stones make up 3 to 8 percent of its A1, C1, and C2 horizons. Also, its IIC horizon contains stones, cobblestones, and pebbles in some places. The hazard of erosion is moderate.

Included with this soil are small areas of the sandy Maynard Lake soils and the very gravelly, coarse-textured Carrizo soils in narrow, deeply cut drainage channels and on small alluvial fans. Also included are short, very steep, gravelly and cobbly escarpments. These inclusions occupy about 5 percent of the total acreage.

The vegetation on this soil is used for limited grazing by livestock. In areas managed for cattle, the most valuable plants are big galleta and Nevada ephedra. Stones on the soil surface make the movement of vehicles difficult and hazardous. (Capability unit VIIs-8; dryland)

Alko-Tickapoo-Rock land association, 2 to 8 percent slopes (AmB).—This mapping unit occurs on gently sloping and moderately sloping alluvial fans and the intermingled outcrops of more strongly sloping rock. It lies at elevations between 5,200 and 5,800 feet in the northwestern part of the Penoyer Valley. The vegetation is mainly galleta, Indian ricegrass, spiny hopsage, Anderson wolfberry, littleleaf horsebrush, and Mormon-tea.

About 40 percent of the association is Alko gravelly loam, 2 to 4 percent slopes; 30 percent is Tickapoo stony sandy loam, 2 to 8 percent slopes; 20 percent is Rock land, a miscellaneous land type; and 10 percent is included areas of soils and terrace escarpments.

Alko gravelly loam is on dissected old alluvial fans that lie in positions higher than those of Tickapoo stony sandy loam. The Alko soil has a profile that is somewhat similar to the one described as representative of the series. It contains a hardpan and, unlike the Tickapoo soil, lacks a fine-textured subsoil. In contrast to the representative Alko soil, however, this soil is covered with a gravel pavement, has a gravelly loam surface layer 4 to 6 inches thick, and contains gravel that makes up 15 to 30 percent of the volume throughout the profile.

Tickapoo stony sandy loam, on dissected alluvial fans, has a fine-textured subsoil and a thin, strongly cemented hardpan. Its profile is similar to that described under the Tickapoo series, but about 10 percent of its surface is covered with stones. In addition, strongly cemented strata in the C horizon alternate with weakly cemented strata, and there is no intervening loose material. Silica-cemented, or opal, bands are generally thicker and more abundant in this soil than in the representative Tickapoo soil, but the bands are discontinuous.

Rock land consists mainly of rhyolitic and tuffaceous rocks that crop out amid the soils of the association. Each area is made up of rocks and stony, very shallow soil material. Most of the areas are less than 10 acres in size, but several at the higher elevations cover more than 50 acres.

The inclusions are mainly gravelly and very gravelly Leo soils in deeply entrenched, intermittent drainage channels; short, very steep, stony escarpments; small areas of stony Alko soils and very stony Tickapoo soils; and a few small areas of eroded Alko soils in which the hardpan is exposed.

The soils in this association are used as range that furnishes limited grazing for livestock. Runoff is very slow, and the hazard of erosion is slight. On range that is managed for cattle, the most valuable plants are Indian ricegrass, desert needlegrass, and galleta. Because the soils are stony or gravelly and have a thin root zone, they are not suitable for cropping and irrigating. The primary use for Rock land is habitat for upland birds. (Alko soil: capability unit VIIs-8, dryland; Tickapoo soil: capability unit VIIs-4, dryland; Rock land: capability unit VIIIs-7, dryland)

Ash Springs Series

The Ash Springs series consists of somewhat stratified, medium-textured and moderately coarse textured soils that are slightly affected by salts. These soils developed in sediments deposited on nearly level flood plains throughout the Pahranagat Valley. The sediments were derived from various igneous and sedimentary rocks, and they have been modified by lime that was precipitated from upward moving ground water.

Representative profile of an Ash Springs soil, located about 200 feet north and 400 feet east of the south quarter corner of section 11, T. 8 S., R. 61 E.:

A—0 to 13 inches, light-gray (10YR 7/1) silt loam, dark gray (10YR 4/1) when moist; massive (structureless) or weak, medium and fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant fine and medium roots; many fine and very fine interstitial and tubular pores; violently effervescent; pH 8.6; clear, smooth boundary.

C1—13 to 24 inches, light-gray (10YR 7/2) micaceous fine sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many very fine and fine tubular and interstitial pores; violently effervescent; pH 8.6; clear, smooth boundary.

C2ca—24 to 37 inches, white (10YR 8/2) silt loam, grayish brown (10YR 5/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine and fine roots; many very fine interstitial pores, and few very fine tubular pores; violently effervescent; pH 8.4; clear, wavy boundary.

C3—37 to 43 inches +, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; many very fine interstitial pores; violently effervescent; pH 8.3.

Silt loam is the dominant texture throughout the profile, but in places there are strata of fine sandy loam, sandy loam, loam, and silty clay loam. The depth to white silt loam, which resembles marl, ranges from 18 to 36 inches. In some places as much as 50 percent of this horizon is extremely hard nodules cemented with lime. Reddish or yellowish iron mottles may occur below a depth of 36 inches. In places there are layers of muck below 36 inches. Normally, the reaction decreases with depth and ranges from very strongly alkaline to moderately alkaline. In most areas the A horizon contains enough salt that plants are slightly affected, but some areas have been reclaimed.

These soils are poorly drained or somewhat poorly drained as a result of ascending and migrating water from thermal springs. The water table fluctuates between the depths of 18 and 36 inches in poorly drained areas, and between 36 and 54 inches in somewhat poorly drained areas. In all areas the water table is highest in winter.

Permeability is moderately slow, but the root zone is very deep, and the available water capacity and natural fertility are high. Runoff is very slow, and there is little or no erosion hazard.

Most of the better drained areas of Ash Springs soils are used as cropland. Here, alfalfa is grown in rotation with corn or small grains, or legumes and grasses are used for pasture. Molybdenum toxicity in grazing animals is common where introduced species of clover are grown. The rest of the better drained areas are mainly in inland saltgrass that is pastured. The poorly drained areas are in meadow grasses that are cut for hay or are grazed.

Ash Springs fine sandy loam, somewhat poorly drained (An).—This nearly level, somewhat poorly drained soil lies in slightly higher areas on the flood plain that are adjacent to alluvial fans. Here, it has been covered by 14 to 22 inches of moderately coarse textured material, mainly fine sandy loam, that washed from higher soils. In other respects the profile is similar to the one described for the series. The water table fluctuates between the depths of 36 and 54 inches most of the year. The vegetation is mainly inland saltgrass, and there are scattered greasewood and quailbush plants.

Included with this soil are small areas in which the surface layer is loamy fine sand or fine sand 3 to 8 inches thick. Also included are small areas that are salt free or are strongly affected by salts. These inclusions account for about 10 percent of the total acreage.

This soil is in inland saltgrass that is pastured by cattle. In addition, it provides habitat for wildlife. It would be suitable for developing as cropland if water were made available for irrigation. Alfalfa, small grain, and pasture could be grown, but some leveling would be needed to prepare fields for irrigation. (Capability unit IIw-69, irrigated; VIIw-6, dryland)

Ash Springs silt loam, somewhat poorly drained (Ap).—This nearly level soil occupies narrow tracts along the sides of wet areas on the Pahranagat Valley flood plain. It has a fluctuating water table that is within 36 to 54 inches of the surface throughout the year.

Small areas having a salt-free surface layer are included with this soil, and so are undisturbed, slightly undulating areas in which there are ridges or high spots that are moderately or strongly affected by excess salts. These inclusions make up about 10 percent of the total acreage.

Most of this soil is used for irrigated alfalfa, small grain, and pasture. The rest is used for unimproved native meadow and for wildlife. (Capability unit IIw-69, irrigated)

Ash Springs silt loam (Ao).—This nearly level, poorly drained soil occurs mostly in the northern half of the Hiko and Ash Springs watershed, where the natural drainage downstream has been partially blocked by the encroachment of alluvial fans. It has a high water table that fluctuates between the depths of 18 and 36 inches most of the year.

Included with this soil are small, depressional, very poor drained areas in which water accumulates on the surface and causes the uppermost 18 inches of the soil to be wet most of the year. In these areas peat or muck occurs either as a thin layer on the surface or as thin strata in the profile. Also included are fairly large areas where the soil is free of salts to a depth of 6 to 8 inches but where the salt concentration increases abruptly below that depth. These inclusions make up about 20 percent of the total acreage.

This soil is used for unimproved meadow of native plants that are cut for hay or grazed. It also is used as habitat for wildlife. To improve irrigation in pastured areas, leveling or smoothing is needed, and shallow drains may be required for removing excess water. (Capability unit IIIw-69P, irrigated)

Ash Springs silty clay loam (As).—This nearly level, poorly drained soil occurs along the wet, smooth, nearly level flood plain in Pahranagat Valley. Except for its silty clay loam A and C1 horizons, it has a profile that is similar to the representative one described. Its A and C1 horizons range from 20 to 30 inches in total thickness. The water table fluctuates between the depths of 18 and 36 inches throughout the year.

Included with this soil are small, depressional, very poorly drained areas in which the soil may contain strata of peat 1 to 4 inches thick. Also included are areas where the topmost 6 to 8 inches of the soil are salt free. These inclusions occupy about 15 percent of the total acreage.

This soil is used for unimproved native meadow and for wildlife. The meadow plants are cut for hay or are grazed. In areas used for pasture, leveling or smoothing is needed for improving irrigation. Also, shallow drains are needed in some places to remove surplus water. The soil can be worked only at certain times because it is sticky when wet. (Capability unit IIIw-69P, irrigated)

Ash Springs silt loam, reclaimed (Ar).—This nearly level soil is free of excess salts in the A, C1, and C2 horizons, but otherwise it is similar to the soil described for the series. It lies along the outer edges of the flood plain and is one of the most productive soils in Pahranagat Valley.

Included are small areas of Ash Springs silt loam, somewhat poorly drained, and Pahranagat silt loam. These inclusions, which make up about 5 percent of the total acreage, occur in the area of transition between this reclaimed soil and the adjacent soils.

Irrigated crops, principally alfalfa, small grain, and pasture, are grown on this soil. In addition, habitat for upland and migratory wildlife is provided. Irrigation water must be managed with care to keep the water table from rising and to maintain a favorable salt balance in the soil. (Capability unit IIw-9, irrigated)

Ash Springs Series, Heavy Subsoil Variants

The heavy subsoil variants from the normal Ash Springs soils are somewhat stratified, fine-textured soils on the smooth, nearly level flood plain in the northern part of the Pahranagat Valley. These soils developed in sediments deposited along stream channels. The sediments were derived from many kinds of rock, principally limestone, ignimbrite, dolomite, shale, and quartzite.

Representative profile of an Ash Springs soil, heavy subsoil variant, located about 1,200 feet south of the center of section 14, T. 5 S., R. 60 E.:

A11—0 to 2½ inches, grayish-brown (10YR 5/2) silt loam, very dark gray (10YR 3/1) when moist; massive (structureless) or weak, medium and fine, subangular blocky structure; slightly hard when dry, friable

when moist, slightly sticky and slightly plastic when wet; abundant very fine roots, and a few fine and medium roots; few very fine tubular and interstitial pores; strong effervescence; pH 8.8; clear, smooth boundary.

IIA12—2½ to 20 inches, gray (10YR 5/1), stratified silty clay loam and silty clay, very dark gray (10YR 3/1) when moist; common, fine, distinct filaments of gray (5Y 6/1) lime, and few, medium, distinct, black (10YR 2/1) organic stains; massive (structureless) but breaks to weak, fine and medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; plentiful very fine roots, and few fine and medium roots; few very fine tubular pores, and few fine interstitial pores; strong effervescence; pH 8.6; gradual, smooth boundary.

IIC1—20 to 36 inches, light-gray (10YR 6/1) clay and fine strata of silty clay loam, very dark gray (10YR 3/1) when moist; common, fine, distinct, gray (5Y 6/1) filaments of lime, and few, medium, distinct, black (10YR 2/1) organic stains; massive; hard when dry, firm when moist, very sticky and very plastic when wet; few very fine and medium roots; few fine and very fine interstitial pores; few, fine, very hard lime nodules; strong effervescence; pH 8.6; gradual, smooth boundary.

IIC2—36 to 50 inches, light-gray (10YR 7/1) clay and thin strata of clay loam, dark gray (10YR 4/1) when moist; few, medium, distinct, black (10YR 2/1) organic stains, and few, fine, distinct, gray (5Y 6/1) filaments of lime; massive; hard when dry, firm when moist, very sticky and very plastic when wet; very few very fine roots; few fine and very fine tubular pores; strong effervescence; pH 8.6; abrupt, smooth boundary.

IIIC3—50 to 60 inches +, light-gray (10YR 7/1) silt loam, gray (5Y 5/1) when moist; common, fine, faint, gray (5Y 6/1) filaments of lime, and few, medium, distinct, very dark gray (10YR 3/1) organic stains; massive; slightly hard when dry, friable when moist, nonsticky and slightly plastic when wet; very few very fine roots; common very fine interstitial pores; strong effervescence; pH 8.5.

The texture throughout the profile is clay, silty clay, silty clay loam, clay loam, or silt loam. If the material in the profile is mixed, more than 35 percent of the mixture is clay. Fine to coarse segregations of lime may occur in almost any horizon, but not within 12 inches of the surface. In some places there are organic stains, as well as stains of iron and manganese, in the lower part of the A horizon and in the C horizon. The reaction ranges from moderately alkaline to very strongly alkaline. The alkalinity is strongest in the A11 horizon and decreases with depth.

These soils are poorly drained or somewhat poorly drained because water moves into them from thermal springs. The water table fluctuates between the depths of 10 and 30 inches in poorly drained areas and from one depth to another below 30 inches in somewhat poorly drained areas. Generally, the water table is highest in winter. Runoff is very slow, permeability is slow, and the available water capacity is high. The soils are high in natural fertility and have a very deep root zone. There is little or no hazard of erosion.

Most areas of these soils are used to produce meadow grasses for hay or pasture. The productivity and quality of meadow depend on the adequacy of drainage and the salt content in the surface layer. The remaining acreage is used for crops. Alfalfa is produced in rotation with corn or small grain, or selected grasses and legumes are grown for pasture. Molybdenum toxicity in grazing animals is common in pasture where clover is grown.

Ash Springs silt loam, heavy subsoil variant, somewhat poorly drained (At).—This inextensive soil lies south of Hiko Spring in Pahranagat Valley. It has a high water table that fluctuates between the depths of 36 and 60 inches, but it is not affected by excess salts.

Included with this soil are small areas that are slightly saline and small areas of salt-free Ash Springs soils. These inclusions make up less than 10 percent of the total acreage.

Although a small acreage is used for meadow, this soil is used mainly as irrigated cropland and for wildlife. All crops suited to the climate can be grown, but alfalfa and small grain are the principal crops and are grown in rotation. Leveling is needed in some areas to improve the spread of irrigation water. (Capability unit IIw-9, irrigated)

Ash Springs silt loam, heavy subsoil variant, slightly saline (Au).—Most areas of this soil are near Frenchy Lake and in the northern half of the Crystal Spring watershed. Drainage is poor in this soil, and the A horizon contains a slight concentration of salts. The water table fluctuates between the depths of 10 and 30 inches most of the year.

Included with this soil, in depressional sloughlike areas, are small tracts of Pahranagat-Ash Springs complex, seeped. Also included are small mounds that are not irrigated and contain a strong concentration of salts. These inclusions occupy about 10 percent of the total acreage.

This soil is in meadow that is used for pasture or hay, and it provides habitat for wildlife. It is suited to crops that are tolerant of water and salts. Leveling is needed for improved irrigation, but the depth of cut is limited because the water table is so high. (Capability unit IVw-369P, irrigated)

Ash Springs silty clay loam, heavy subsoil variant, slightly saline (Av).—This poorly drained soil occurs in the uppermost parts of the Crystal Spring and Hiko Spring watersheds. Except for its 6- to 11-inch A11 horizon of silty clay loam, which is slightly salt affected, it has a profile that is similar to the representative one described. The water table fluctuates between the depths of 10 and 30 inches throughout the year, but generally it is highest in winter.

Included with this soil, in meanders formed by old streams, are small areas of Pahranagat-Ash Springs complex, seeped. Also included are high ridges and knolls that are moderately or strongly affected by salts. These inclusions make up about 10 percent of the total acreage.

In some areas this soil has been leveled and is cultivated. The remaining acreage is in meadow that is pastured or is harvested for hay. Also, the soil is used as habitat for wildlife. If additional areas are brought under cultivation, leveling will be needed and can best be done early in fall when the water table is lowest. (Capability unit IVw-369P, irrigated)

Aysees Series

Soils of the Aysees series consist of moderately coarse textured material underlain by very gravelly, coarse textured material. These soils developed in alluvium that makes up nearly level to gently sloping alluvial fans in

Penoyer Valley. The alluvium was derived from limestone, dolomite, shale, sandstone, quartzite, and tuff.

Representative profile of an Aysees soil, located about 790 feet west of the center of section 31, T. 3 S., R. 56 E.:

A1—0 to 4 inches, light-gray (10YR 7/2) fine gravelly sandy loam (30 to 40 percent gravel), brown (10YR 5/3) when moist; weak, thick, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; very few fine roots; many fine and medium vesicular pores; strongly effervescent; pH 8.3; abrupt, smooth boundary.

C1—4 to 15 inches, very pale brown (10YR 7/3) fine sandy loam, (2 to 3 percent gravel), brown (10YR 5/3) when moist; massive; slightly hard when dry, friable when moist, nonsticky and slightly plastic when wet; abundant very fine and fine roots; many very fine and fine tubular pores; some of the pebbles have a small amount of lime on lower side; strongly effervescent; pH 8.9; clear, wavy boundary.

IIC2ca—15 to 22 inches, light-gray (10YR 7/2) gravelly sandy loam, (30 to 40 percent pebbles coated with lime on all sides), grayish brown (10YR 5/2) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine roots; very porous; violently effervescent; pH 9.1; clear, wavy boundary.

IIIC3—22 to 60 inches +, grayish-brown (10YR 5/2) very gravelly sand (60 to 70 percent gravel, the pebbles thinly coated with lime on under side only), dark grayish brown (10YR 4/2) when moist; single grain; loose when dry or moist; very porous; plentiful very fine and fine roots; strongly effervescent; pH 8.1.

The depth to very gravelly sand ranges from 12 to 24 inches. In places as much as 40 percent of the A and upper C horizons is gravel. In the IIIC3 horizon, the gravel content ranges from 60 to 80 percent.

The Aysees soils are well drained or somewhat excessively drained. Runoff is slow, and the available water capacity is low. Permeability is moderately rapid in the upper part but is very rapid in the very gravelly lower part. Natural fertility is moderate, and the root zone is very deep. Soil blowing is a severe hazard. Some areas are slightly affected by salts and alkali.

These soils are used to provide limited grazing for livestock. They are suitable for cropping if water is made available for irrigation.

Aysees gravelly sandy loam, 0 to 2 percent slopes (AyA).—Most of this soil is north of State Route 25 on the eastern side of Penoyer Valley, where alluvial fans merge with the playa. The soil is very strongly alkaline and, in the surface layer, contains a slight concentration of soluble salts and alkali. The A1, C1, and IIC2ca horizons range from 18 to 24 inches in total thickness and have a gravel content of as much as 25 percent. The vegetation is mainly galleta, bud sagebrush, winterfat, and shadscale.

Included in areas mapped as this soil are many, broad, shallow drainage channels that contain very gravelly Bluewing soils. Also included are small areas (less than 3 acres in size) of playa. These inclusions occupy less than 10 percent of the total acreage.

This soil is in range that is grazed by livestock, and it also provides habitat for some kinds of wildlife. The most valuable plants on range managed for cattle are winterfat, galleta, bud sagebrush, and shadscale. If irrigation water is made available, the soil is suitable for development as cropland. Leveling is needed to prepare fields for irrigation, but soil blowing is a hazard if the surface is left unprotected for a long time. (Capability unit IIIs-4, irrigated; VIIs-4, dryland)

Aysees gravelly sandy loam, 2 to 4 percent slopes (AyB).—Most of this gently sloping soil is north of State Route 25 on the eastern side of Penoyer Valley. The A1, C1, and IIC2ca horizons have a combined thickness ranging from 12 to 16 inches, and their gravel content ranges from 25 to 40 percent. The vegetation is mainly shadscale, winterfat, and bud sagebrush, and there is some galleta.

Included with this soil, in narrow and shallow drainage channels, are small areas of very gravelly Cliffdown and Bluewing soils. Also included are small areas of an unnamed soil that has a very gravelly, moderately coarse textured subsoil. These inclusions make up less than 15 percent of the total acreage.

This soil is used only as range for livestock and as habitat for wildlife, but it can be prepared for irrigated crops if water is made available. On range managed for cattle, the most valuable plants are winterfat, galleta, bud sagebrush, and shadscale. (Capability unit IIIe-4, irrigated; VIIs-4, dryland)

Bastian Series

Soils of the Bastian series are medium textured, are affected by salts and alkali, and contain nodules weakly cemented with silica. These soils formed in alluvium that was derived mainly from ignimbrite but that included silty lakebed material, dolomite, and limestone. They occupy the outer flanks of flood plains and the toe slopes of alluvial fans in Pahranagat Valley.

Representative profile of a Bastian soil, located about 1,000 feet south and 300 feet west of the center of section 11, T. 5 S., R. 60 E.:

A1—0 to 6 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few medium and coarse rhizomes of saltgrass; few fine interstitial pores; violently effervescent; pH 9.6 at surface, 9.2 in rest of horizon; clear, smooth boundary.

C1—6 to 16 inches, very pale brown (10YR 7/3) silt loam, dark brown (10YR 4/3) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant very fine, fine, and medium roots and rhizomes of saltgrass; few very fine tubular pores, and many micro and very fine interstitial pores; violently effervescent; pH 9.3; clear, smooth boundary.

C2si—16 to 22 inches, light-gray (10YR 7/2) silt loam, dark grayish brown (10YR 4/2) when moist; massive (structureless), but about 30 percent of horizon consists of brittle, very fine, subangular blocky aggregates that are weakly cemented by silica; hard and very hard when dry, friable and firm when moist; slightly sticky and slightly plastic when wet; abundant very fine and medium roots and rhizomes of saltgrass; few to common, fine and very fine tubular pores; violently effervescent; pH 9.3; clear, smooth boundary.

C3si—22 to 37 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) when moist; massive (structureless) but with silica-cemented fragments as in C2si horizon; hard and very hard when dry, friable and firm when moist, slightly sticky and slightly plastic when wet; plentiful fine and very fine roots; few to common, fine and very fine tubular pores; violently effervescent; pH 9.2; clear, smooth boundary.

C4si—37 to 50 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; massive, but about 80 percent of horizon consists of brittle, medium, subangular blocky aggregates that appear to be weakly cemented by silica; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine and fine roots; few to common, fine and very fine tubular pores; violently effervescent; pH 9.0; clear, smooth boundary.

C5—50 to 60 inches +, light-gray (10YR 7/2) heavy fine sandy loam, brown (10YR 5/3) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; violently effervescent; pH 9.0.

The depth to the Csi horizon ranges from 6 to 26 inches, and the combined thickness of the Csi horizons ranges from 10 to 45 inches. In some places the profile is stratified with layers of loam, fine sandy loam, or silty clay loam. The A horizon is affected by soluble salts, and the Csi horizons contain a strong concentration of salts.

Drainage is somewhat poor in the Bastian soils. Runoff is very slow or slow, permeability is moderately slow, and the available water capacity is high. The water table fluctuates between the depths of 36 and 60 inches throughout the year, but it is highest in winter. Bastian soils are high in natural fertility and have a very deep root zone. They are slightly susceptible to erosion.

These soils are used for grazing and as habitat for small species of wildlife. In some areas the production of inland saltgrass is increased by use of water spreading. Cultivated crops can be grown in areas where water is available for irrigation.

Bastian fine sandy loam, strongly saline (Ba).—This soil occupies many small alluvial fans north of Hiko Lake, on the western side of the Crystal Spring watershed in Pahranagat Valley. In the uppermost 10 to 15 inches, the soil consists of fine sandy loam that is strongly affected by salts, but in other respects it has a profile similar to the one described for the series. The water table fluctuates between the depths of 48 and 60 inches most of the year.

Included with this soil are scattered small areas in which more than 15 percent of the soil surface is covered with gravel. These areas make up less than 5 percent of the total acreage.

Range and habitat for upland wildlife are the uses made of this soil. Areas covered by inland saltgrass are grazed in conjunction with lower lying meadows. Dryland areas are small but are suitable for irrigated pasture wherever water is available. On range managed for cattle, alkali sacaton and inland saltgrass are the most important plants. (Capability unit IIw-6, irrigated; VIIw-6, dryland)

Bastian silt loam, moderately saline (Bc).—This soil lies on nearly level flood plains in the Crystal Spring watershed. It contains a moderate concentration of soluble salts in the A1 and C1 horizons, but its profile is similar to the representative one described. During most of the irrigation season, the water table is 54 to 60 inches below the surface.

Included with this soil, in slight depressions, are small areas of Ash Springs silt loam. Also included are a few scattered areas on small, gently sloping alluvial fans, where the average slope is 3 percent. These inclusions account for about 10 percent of the total acreage.

This soil is used for livestock grazing and for wildlife. It can be leveled and used for irrigated crops wherever water is available. Alkali sacaton and inland saltgrass are the most important plants in grazing areas that are managed for cattle. (Capability unit IIw-6, irrigated; VIIw-6, dryland)

Bastian silt loam, strongly saline (Bd).—This soil is mainly near Frenchy Lake and in the northern part of the Crystal Spring watershed. It has a profile that is similar to the one described for the series, but it is strongly affected by soluble salts to a depth of about 22 inches. The water table fluctuates from 36 to 42 inches below the surface most of the year.

Included in areas mapped as this soil are small areas of poorly drained Bastian soils in swales and of moderately well drained Bastian soils on isolated mounds. These inclusions occupy about 10 percent of the total acreage.

This soil is used for range and as habitat for wildlife. In the management of grazing areas for cattle, alkali sacaton and inland saltgrass are the most important plants. Where water is available, the soil can be leveled and irrigated. (Capability unit IIw-6, irrigated; VIIw-6, dryland)

Belted Series

In the Belted series are slightly saline, moderately coarse textured and moderately fine textured soils that contain a duripan strongly cemented with silica. These soils developed in alluvium derived principally from basalt, andesite, and tuff. They are on nearly level alluvial terraces that lie on older lakebed and basin deposits in Penoyer Valley.

Representative profile of a Belted soil, located about 950 feet north and 500 feet west of the south quarter corner of section 17, T. 3 S., R. 55 E. (laboratory data for this soil are given in tables 9 and 10):

A1—0 to 3 inches, light-gray (10YR 7/2) coarse sandy loam, brown (10YR 5/3) when moist; weak, thick, platy structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; devoid of plant roots; many very fine and fine vesicular pores; strongly effervescent; pH 8.8; abrupt, wavy boundary.

B2t—3 to 7 inches, light-gray (10YR 7/2) sandy clay loam, dark brown (10YR 4/3) when moist, brown (10YR 5/3) when moist and rubbed; weak, thick, platy structure breaking readily to moderate, medium and fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky and plastic when wet; plentiful very fine and fine roots; few fine tubular pores, and many very fine and fine interstitial pores; common thin clay films on ped faces and in pores; slightly effervescent; pH 8.6; abrupt, smooth boundary.

C1sicam—7 to 11 inches, very pale brown (10YR 7/3), strongly cemented duripan, dark brown (10YR 4/3) when moist, brown (10YR 5/3) when moist and rubbed; strong platy structure; abundant very fine and fine roots, and a few medium roots between plates; common fine tubular pores, and many very fine and fine interstitial pores; noneffervescent in the interior of plates, violently effervescent on outer faces of plates where white (10YR 8/2) segregated lime occurs; pH 8.8; abrupt, wavy boundary.

C2—11 to 24 inches, light-gray (10YR 7/2) sandy loam, brown (10YR 5/3) when moist; massive; hard when dry, friable when moist, nonsticky and nonplastic when wet; very few very fine and fine roots; common fine tubular pores, and many very fine interstitial pores;

noneffervescent except where few, thin, white (10YR 8/2) filaments of lime occur; pH 8.8; clear, smooth boundary.

C3—24 to 32 inches, light-gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) when moist; massive; hard when dry, friable when moist, nonsticky and nonplastic when wet; very few very fine and fine roots; few fine tubular pores, and many fine interstitial pores; slightly effervescent; pH 8.8; abrupt, smooth boundary.

IIC4—32 to 40 inches, light-gray (10YR 7/2) loam or silt loam, brown (10YR 5/3) when moist; with few, fine, medium and coarse, distinct mottles of reddish-brown (5YR 4/4) and dark reddish-brown (5YR 3/4) iron; massive; very hard when dry, very firm when moist, slightly sticky and slightly plastic when wet; few very fine roots; few micro and very fine interstitial pores; generally noneffervescent, but slightly effervescent where few, faint, white (10YR 8/2) lime filaments and pockets of lime occur; pH 8.6; clear, smooth boundary.

IIC5—40 to 60 inches +, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; with few, fine, medium and coarse, distinct mottles of dark reddish-brown (5YR 3/4) and reddish-brown (5YR 5/4) iron; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; noneffervescent, except for an occasional light-gray (10YR 7/1) filament, vein, or pocket of lime; pH 8.6.

The silica-cemented duripan ranges from 6 to 14 inches in depth and from 4 to 12 inches in thickness. In some places there are very thin, discontinuous, indurated lenses. Only a few of these are more than 1/32 inch thick. The depth to the IIC horizon of unconformable lake-laid material ranges from 26 to 40 inches. The reaction is strongly alkaline or moderately alkaline and generally decreases with depth.

These soils are well drained and have slow runoff. Permeability is very slow through the duripan and the underlying lake sediments. The available water capacity is very low, natural fertility is very low, and the effective root zone is very shallow. Erosion is a slight hazard.

Belted sandy loam (Bs).—This soil occupies a smooth, nearly level terrace that is adjacent to the southwestern corner of the playa in Penoyer Valley. The area is crossed by State Route 25. The vegetation consists of shadscale, graymolly, Nuttall saltbush, and annuals.

Included with this soil are small hummocks and low ridges of sandy material that was deposited by wind on the Belted soil. These hummocks and ridges normally are only 4 to 6 inches high, but some are as much as 12 inches high. Also included, adjacent to the playa, are eroded areas of Belted sandy loam that were washed by runoff from high-intensity thunderstorms in summer. These inclusions make up about 5 percent of the total acreage.

This soil provides limited grazing for livestock. On range managed for cattle, the most valuable plants are graymolly and shadscale. The soil is not suitable for cultivation or for irrigation, because it is very shallow and has very low available water capacity. (Capability unit VIIs-8, dryland)

Bluewing Series

In the Bluewing series are very gravelly, coarse-textured soils that developed in sediments deposited along gently sloping to moderately sloping drainageways, flood plains, and alluvial fans in Penoyer Valley. The sediments were derived mainly from rhyolite, andesite, and basalt.

Representative profile of a Bluewing soil, located near the center of section 5, T. 4 S., R. 56 E.:

A1—0 to 2 inches, light brownish-gray (10YR 6/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine and medium roots; few fine and common very fine vesicular pores; strongly effervescent; pH 8.6; clear, smooth boundary.

C1—2 to 10 inches, light brownish-gray (10YR 6/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine, fine, and medium roots; many very fine and fine interstitial pores; strongly effervescent; pH 8.6; clear, smooth boundary.

C2ca—10 to 25 inches, light brownish-gray (10YR 6/2) very gravelly and cobbly loamy coarse sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry or moist; plentiful very fine roots; many, very fine and fine and few, medium interstitial pores; strongly effervescent, with very thin lime crusts on bottom side of pebbles; pH 8.8; clear, smooth boundary.

C3—25 to 60 inches +, light brownish-gray (10YR 6/2) very gravelly coarse sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry or moist; few very fine roots; many very fine and fine, and few medium interstitial pores; strongly effervescent; pH 8.6.

The gravel content throughout the profile ranges from 50 to 80 percent. In some places, particularly between the surface and a depth of 30 inches, the content of cobblestones is as much as 25 percent. The reaction is moderately alkaline or strongly alkaline.

These soils are excessively drained. Runoff is very slow, permeability is very rapid, and the available water capacity is very low. Although the root zone is very deep, natural fertility is very low. The hazard of erosion is slight or moderate, depending on position and slope.

Bluewing very gravelly loamy sand, 2 to 12 percent slopes (BuC).—This soil occupies gently sloping to strongly sloping flood plains and alluvial fans on both sides of Penoyer Valley in the south-central part. The plant cover consists of Mormon-tea, littleleaf horsebrush, galleta, winterfat, and annuals.

Included with this soil are small areas of riverwash; small areas of a soil that is like a Bluewing soil but is shallow to an unrelated hardpan or to bedrock; and small areas of Bluewing soils that are stony, very stony, or cobbly. These inclusions make up about 10 percent of the total acreage.

This soil is in range that provides limited grazing for livestock. It is too droughty and too gravelly for use as cropland. On range managed for cattle, the most important plants are winterfat, Mormon-tea, and galleta. (Capability unit VIIs–L, dryland)

Carrizo Series

The Carrizo series consists of very gravelly and cobbly, coarse-textured soils that occupy nearly level to strongly sloping flood plains and small alluvial fans. These soils developed in alluvium derived from various kinds of

rocks, principally limestone and rhyolite. They occur in numerous washes throughout Pahranagat Valley.

Representative profile of a Carrizo soil, located about 1,200 feet east and 100 feet north of the southwest corner of section 4, T. 9 S., R. 62 E.:

A1—0 to 6 inches, pale-brown (10YR 6/3) stony and cobbly loamy sand, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; very few fine and medium roots; many very fine and fine interstitial pores; strongly effervescent; pH 8.4; clear, irregular boundary.

C—6 to 60 inches +, very gravelly and cobbly coarse sand, same color as A1 horizon; about 90 percent of this material is gravel or cobblestones; single grain; loose when dry or moist; very few very fine roots; many fine and medium interstitial pores; strongly effervescent; pH 8.6.

The content of coarse fragments in these soils ranges from 60 to 90 percent. From 40 to 90 percent of the fragments is gravel, and as much as 40 percent is stones and cobblestones. The texture is commonly uniform throughout the profile, but there may be strata of loamy sand or sand that are not gravelly. In some places the surface is covered with a vesicular crust as much as 3 inches thick. In some areas where the Carrizo soils adjoin wet soils on the flood plain, they contain excess salts and alkali. The reaction ranges from moderately alkaline to very strongly alkaline.

These soils are excessively drained. Runoff is very slow, permeability is very rapid, and the available water capacity is very low. The soils are very low in natural fertility, but they have a very deep root zone. They are moderately susceptible to erosion.

Almost all areas of Carrizo soils are covered with natural vegetation that provides limited grazing for livestock. At the toe of alluvial fans, where water is available for irrigation, a few small areas are cultivated.

Carrizo gravelly sand, 0 to 12 percent slopes (CaC).—This nearly level to strongly sloping soil occurs in many narrow washes and on small alluvial fans adjacent to the Pahranagat Valley flood plain. It has an A1 horizon of gravelly sand, but in other respects its profile is similar to the one described for the series. The profile is gravelly throughout. In addition, stones and cobblestones occupy as much as 10 percent of the volume in the C horizon, though they make up less than 5 percent of the A horizon.

Included are large areas of Carrizo gravelly loamy sand that occupy as much as 30 percent of areas mapped as this soil. Also included are two small areas of Carrizo gravelly sand and stony loamy sand that are slightly or moderately affected by excess salts. These saline inclusions, which make up less than 10 percent of the total acreage, lie on toe slopes of alluvial fans just above the flood plain. Here, they accumulate soluble salts through the rise and evaporation of saline water from adjoining wet soils.

The vegetation is variable but consists mainly of creosotebush and white bur-sage. In addition, there is some shadscale, spiny hopsage, and galleta, and some rubber rabbitbrush along drainage channels. Also common in the plant cover are Anderson wolfberry and desert pearl at the higher elevations and fourwing saltbush, quailbush, and greasewood in the saline inclusions on toe slopes of alluvial fans.

Most of this soil is in range that provides limited grazing for livestock. At the tips of alluvial fans, however, there are areas of less than 2 acres that are included in irrigated fields and are cropped to alfalfa in rotation with small grain. Yields are low because the soil is droughty. Except in areas that are more easily kept in a field than bypassed, this soil should not be used for cultivated crops. Where the natural vegetation is managed for cattle, the most important plants are spiny hopsage, shadscale, and big galleta. (Capability unit VIIs–L, dryland)

Carrizo stony loamy sand, 0 to 12 percent slopes (CbC).—This is the most extensive soil in the Carrizo series. It occurs in numerous washes and on small alluvial fans adjacent to the Pahranagat Valley flood plain. Cobblestones and stones make up 10 to 40 percent of the volume throughout the profile.

Included with this soil are large areas of Carrizo stony sand that account for about 30 percent of the total acreage. Also included are small scattered areas of Carrizo gravelly sand, and slightly saline toe slopes of alluvial fans.

The plant cover on this soil varies from place to place. Generally dominant are creosotebush and white bur-sage, together with datil yucca, cactus, white burrobrush, and big galleta. Some rubber rabbitbrush occurs next to drainageways. Near the included saline ends of alluvial fans, there are quailbush, fourwing saltbush, and greasewood.

This soil is used to provide limited grazing for livestock. In areas managed for cattle, the most important plant is big galleta. The soil is not suitable as cropland, because of droughtiness and stones on the surface. (Capability unit VIIs–L, dryland)

Clay Dune Land-Playa Association

Clay dune land-Playa association (Cd) occurs in the northeastern part of the Penoyer Valley floor. It consists of two land types, Clay dune land and Playa, that occupy about equal acreages. A few greasewood plants grow on the clay dunes, but the Playa is bare except for a few seepweed plants scattered around the margin.

Clay dune land is made up of isolated mounds that lie on the surface of the Playa. These mounds are 3 to 12 feet high, have almost vertical side slopes, and consist of pinkish-gray clay that is strongly affected by salts and alkali. Owing to the concentration of soluble salts, the clay is granular to a depth of 1 to 3 inches. Normally, it is very strongly alkaline, though it may be strongly alkaline near the base of the dunes. The origin of the clay is not known, but the dunes may be erosional remnants. They are well drained, have very rapid runoff, are subject to severe erosion, and have slow permeability and high available water capacity. Their natural fertility is high, and their root zone is very thick.

Flat deposits of silty clay make up the Playa. These deposits are covered with water periodically, and they are strongly affected by salts and alkali in the uppermost 3 to 6 inches.

No use is made of the land types in this association. (Clay dune land: capability unit VIIIs–6, dryland; Playa: capability unit VIIIw–F, dryland)

Cliffdown Series

The Cliffdown series consists of gravelly, moderately ~~coarse-textured~~ soils on nearly level to gently sloping alluvial fans. These soils developed in sediments derived from limestone, dolomite, tuff, quartzite, and sandstone. They are in the eastern part of Penoyer Valley.

Representative profile of a Cliffdown soil, located about 500 feet north and 500 feet east of the center of section 33, T. 1 N., R. 56 E.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) gravelly sandy loam (30 percent gravel), dark brown (10YR 4/3) when moist; weak platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine and fine roots; common very fine and fine tubular pores, and many very fine interstitial pores; strongly effervescent; pH 8.6; clear, smooth boundary.

C1—3 to 13 inches, light brownish-gray (10YR 6/2) gravelly fine sandy loam or gravelly light fine sandy loam (30 percent gravel), dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; abundant very fine and fine roots, and few medium roots; many very fine tubular pores, and many micro and very fine interstitial pores; violently effervescent; pH 8.6; clear, smooth boundary.

IIC2—13 to 20 inches, light-gray (10YR 7/2) very gravelly light fine sandy loam (70 percent gravel), brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant; very fine and fine roots, and few medium roots; many micro and very fine interstitial pores; violently effervescent; pH 8.6; clear, smooth boundary.

IIIC3—20 to 32 inches, light-gray (10YR 7/2) gravelly light fine sandy loam (40 percent fine gravel), brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many very fine and fine interstitial pores; violently effervescent; pH 8.8; clear, smooth boundary.

IVC4—32 to 42 inches, light-gray (10YR 7/2) very gravelly light fine sandy loam (70 percent fine gravel), brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; roots and pores as in IIIC3 horizon; violently effervescent; pH 8.5; clear, smooth boundary.

VC5—42 to 52 inches, light-gray (10YR 7/2) gravelly light sandy loam (30 percent gravel), dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine and fine roots; many very fine and fine interstitial pores; violently effervescent; pH 8.5.

A thin vesicular crust generally covers the surface, but it is lacking in some areas. These gravelly soils are normally stratified and are dominantly fine sandy loam or sandy loam in texture. In some places, however, there are thin strata of gravelly loamy sand, gravelly loamy fine sand, or gravelly loam. The content of gravel in individual layers ranges from 10 to 80 percent. The reaction is moderately alkaline or strongly alkaline.

Drainage is good in these soils. Runoff is slow or very slow, permeability is moderately rapid, and the available water capacity is low. Although the root zone is very deep, natural fertility is moderate or low. The hazard of erosion ranges from slight to severe.

All the acreage of Cliffdown soils is in natural vegetation that is used to provide limited grazing for livestock. Most areas can be developed as irrigated cropland if water is made available.

Cliffdown gravelly sandy loam, 0 to 2 percent slopes (CfA).—This soil is on two large alluvial fans in Penoyer Valley, one in the southeastern part, the other in the central-northeastern part. Slopes are long and smooth, and they average about 1 percent. Natural fertility is low. The hazard of erosion is slight. Winterfat, bud sagebrush, and Indian ricegrass are the principal plants.

Included with this soil are spots of nongravelly Cliffdown soils in which the gravel content is only 5 to 10 percent. These inclusions occupy less than 3 percent of the total acreage.

This soil is in range that is used for limited grazing. It also is used for some kinds of upland wildlife. The most important plants on range managed for cattle are winterfat and Indian ricegrass. If water is made available, this soil can be developed as irrigated cropland. (Capability unit IIIs-4; irrigated VIIs-4, dryland)

Cliffdown gravelly sandy loam, 2 to 4 percent slopes, eroded (CfB2).—This extensive soil is on gently sloping alluvial fans below the Worthington Mountains in Penoyer Valley. Slopes are long. The average slope is slightly more than 3 percent, and, except for numerous shallow channels, the relief is smooth. The channels, which average about 12 inches in depth, were formed by runoff from higher lying soils. Natural fertility is low, and the erosion hazard is severe. Winterfat, bud sagebrush, and Indian ricegrass are the principal plants.

Included with this soil are several large areas of Cliffdown gravelly sandy loam that are not eroded. Also included, at the upper end of alluvial fans, are areas in which the surface layer contains cobblestones. These inclusions make up about 20 percent of the total acreage.

This soil is used for limited livestock grazing, and it provides habitat for some kinds of upland wildlife. On range managed for cattle, the most valuable plants are winterfat and Indian ricegrass. Irrigating this soil is feasible if water is made available. (Capability unit IIIe-4, irrigated; VIIs-4, dryland)

Cliffdown loamy sand, 0 to 2 percent slopes (ChA).—This soil occupies a relatively small area on a nearly level alluvial fan north of Shadow Well. It has been covered with sandy material that washed from higher areas, and it consists of loamy sand to a depth of 8 to 15 inches. In this material the content of gravel is less than 10 percent and a vesicular crust is lacking. Natural fertility is low. Littleleaf horsebrush is dominant in the plant cover, together with winterfat, fourwing saltbush, bud sagebrush, galleta, and Indian ricegrass. Small areas of Cliffdown fine sandy loam are included.

This soil is in range, but its use by livestock is limited. It is used by some kinds of upland wildlife. In areas managed for cattle, the most important plants are winterfat, fourwing saltbush, and Indian ricegrass. If water is made available, this soil can be prepared for irrigation and used for crops. (Capability unit IIIs-L, irrigated; VIIs-4, dryland)

Cliffdown sandy loam, 2 to 4 percent slopes (CkB).—This soil occupies a large, uniformly shaped area on an alluvial fan near State Route 25 on the eastern side of Penoyer Valley. The average slope is slightly more than 2 percent. The content of gravel is less than 15 percent to a depth of about 18 inches, but as much as 40 percent of the soil is gravel below that depth. In other respects the profile is similar to the one described as representative of the series. Surface runoff is slow, but the erosion hazard is severe. Natural fertility is moderate. The vege-

tation consists of winterfat, fourwing saltbush, and a small amount of Indian ricegrass and galleta.

Included near the lower edge of the area occupied by this soil is a small area in which dense material like that in a Jarboe soil occurs at a depth of 40 to 50 inches. Also included are small areas of Cliffdown gravelly sandy loam, 0 to 2 percent slopes. These inclusions make up less than 5 percent of the total acreage.

This soil is in range that provides limited grazing for livestock. In addition, it is used by some kinds of upland wildlife. The most important plants on range managed for cattle are winterfat, fourwing saltbush, and Indian ricegrass. If water is made available, this soil can be leveled and used for irrigated crops. (Capability unit IIIe-4, irrigated; VIIs-4, dryland)

Cliffdown very gravelly sandy loam, 2 to 4 percent slopes, eroded (ClB2).—This soil occurs on a large alluvial fan south of State Route 25 on the eastern side of the Penoyer Valley. The fan has an average slope of about 3 percent and is cut by many drainage channels 1 to 3 feet deep. Erosion has thinned this soil, and gravel makes up 60 to 80 percent of the volume in the upper 8- to 15-inch layer, but in other respects the profile is similar to that described for the series. Surface runoff is slow, and the erosion hazard is moderate. Natural fertility is low. Galleta, bud sagebrush, winterfat, and shadscale are the dominant plants.

Included with this soil, near the upper edge of the fan, are small areas in which the soil is cobbly. Also included are small areas that are not so gravelly as this soil, and small areas that are not eroded. These inclusions occupy less than 10 percent of the total acreage.

This soil is used to provide limited grazing for livestock. It is not suitable for crops or for irrigation, because the surface layer is too gravelly. All of the dominant plants are important on range managed for cattle. (Capability unit VIIs-4, dryland)

Crystal Springs Series

In the Crystal Springs series are gravelly, moderately coarse textured and medium-textured soils that have a hardpan cemented with lime. These soils developed in alluvium derived mostly from limestone or dolomite and, to a small extent, from quartzite, sandstone, and ignimbrite. They are on gently sloping to moderately sloping, somewhat dissected, old alluvial fans in Penoyer Valley.

Representative profile of a Crystal Springs soil, located about 600 feet east and 800 feet south of the northwest corner of section 15, T. 4 S., R. 61 E.:

A1—0 to ½ inch, very pale brown (10YR 8/3) gravelly fine sandy loam, grayish brown (10YR 5/2) when moist; weak, thin, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine roots; many fine and medium vesicular pores; violently effervescent; pH 8.8; abrupt, smooth boundary.

C1—½ inch to 11 inches, pale-brown (10YR 6/3) gravelly fine sandy loam, dark brown (10YR 4/3) when moist; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; many fine roots; many very fine and fine tubular and interstitial pores; very violently effervescent; pH 8.6; clear, wavy boundary.

C2ca—11 to 22 inches, white (10YR 8/2) gravelly and cobbly loam, weakly lime cemented, brown (10YR 5/3) when moist; massive; hard when dry, very firm when moist, slightly sticky and slightly plastic when wet; few roots; few fine tubular pores, and many very fine and fine interstitial pores; violently effervescent; pH 8.8; clear, wavy boundary.

Ccam—22 to 42 inches +, white (10YR 8/2), gravelly and cobbly hardpan indurated with lime, pale brown (10YR 6/3) when moist; no roots; very few, very fine and fine pores; many, very thin, dense laminae in the upper 1 to 4 inches; violently effervescent; pH 8.6.

The hardpan ranges from 11 to 24 inches in depth from the surface and from 10 to 36 inches in thickness. The uppermost 1 to 4 inches of the profile may be strongly vesicular, and the surface generally is overlain by a weakly or moderately developed cobblestone or gravel pavement. In the horizons above the hardpan, the content of gravel ranges from 20 to 50 percent, and that of cobblestones is as much as 25 percent. Immediately above the Ccam horizon there may be a considerable amount of disseminated and segregated lime. Throughout the profile the reaction is moderately alkaline to strongly alkaline.

These soils are well drained and have medium runoff, very slow permeability, and very low available water capacity. They are low in natural fertility and have a shallow root zone. Erosion is a moderate hazard.

The Crystal Springs soils are used only to provide grazing for livestock. Because of their very low available water capacity and their limited root zone, they are not suitable for cultivated crops or for irrigation.

Crystal Springs cobbly fine sandy loam, 2 to 8 percent slopes (CmC).—This soil is on gently sloping and moderately sloping alluvial fans that adjoin the Hiko Range in the Pahranagat Area. These fans are deeply dissected by many V-shaped drainage channels. Except for upper horizons of cobbly and gravelly fine sandy loam, 6 to 14 inches thick, the profile of this soil is similar to the one described as representative for the series. The depth to the hardpan ranges from 16 to 22 inches. Most common in the plant cover are shadscale, spiny mendora, Mormon-tea, bud sagebrush, creosotebush, galleta, and bush muhly.

Included in areas mapped as this soil are areas of very steep unnamed soils that occupy the short side slopes along the alluvial fans. These unnamed soils are gravelly and cobbly, are moderately coarse textured, and, at a depth of 16 to 26 inches, contain strata weakly cemented with lime. The inclusions account for about 15 percent of the total acreage.

This soil produces a limited amount of forage that is grazed by livestock. It is not suitable for cultivation or for irrigation, because the root zone is shallow and the available water capacity is very low. The most valuable plants on range managed for cattle are bush muhly, galleta, shadscale, and bud sagebrush. (Capability unit VIIs-8, dryland)

Crystal Springs gravelly loam, 2 to 4 percent slopes (CnB).—This soil occupies a large area on the alluvial fan adjacent to the Worthington Mountains in the Penoyer Area. It has an average slope of about 3 percent and is cut by many drainage channels 2 to 6 feet deep. The surface horizon is 4 to 6 inches of gravelly loam, but in other respects the profile is similar to the one described for the series. The vegetation is mainly littleleaf horsebrush, low Douglas rabbitbrush, Mormon-tea, winterfat, Anderson wolfberry, Indian ricegrass, and galleta.

Included with this soil are areas of very deep, gravelly Cliffdown soils in drainage channels and on short, very steep escarpments. These inclusions make up about 5 percent of the total acreage.

This soil is in range that provides limited grazing for livestock. It is not suitable as irrigated cropland, because it has a shallow root zone and has very low available water capacity. On range managed for cattle, the most important plants are winterfat, Indian ricegrass, and galleta. (Capability unit VIIs–8, dryland)

Crystal Springs-Cliffdown association, 2 to 4 percent slopes (CsB).—This mapping unit lies on gently sloping alluvial fans in the Penoyer Area. These fans were formed by material that washed from the Worthington Mountains. The average slope is about 3 percent, but the surface is cut by many broad drainage channels 2 to 6 feet deep.

About 75 percent of the association is Crystal Springs gravelly loam, 2 to 4 percent slopes; 20 percent is Cliffdown gravelly sandy loam, 2 to 4 percent slopes, eroded; and 5 percent is included small areas of very gravelly Cliffdown soils and cobbly or stony Crystal Springs soils.

Crystal Springs gravelly loam occupies alluvial fans and contains an indurated hardpan at a shallow depth. On this soil the vegetation is littleleaf horsebrush, Mormon-tea, winterfat, Anderson wolfberry, Indian ricegrass, and galleta.

Cliffdown gravelly sandy loam is very deep and occurs in drainage channels. It is covered with almost pure stands of winterfat, together with Indian ricegrass. A detailed description of the Cliffdown soil is given on page 20.

The soils in this association are used as range that provides limited grazing for livestock. They are not suitable for cropping and irrigating. Winterfat and Indian ricegrass are among the important plants on range managed for cattle. In addition, galleta is an important plant in areas of Crystal Springs soil used as range. (Crystal Springs soil: capability unit VIIs–8, dryland; Cliffdown soil: capability unit VIIs–4, dryland)

Fang Series

The Fang series consists of moderately coarse textured soils that formed in alluvium derived from tuff, basalt, and volcanic ash. These soils are on smooth, nearly level to gently sloping flood plains and alluvial fans in Penoyer Valley.

Representative profile of a Fang soil, located about 3,100 feet east and 1,200 feet north of the southwest corner of section 31, T. 3 S., R. 55 E. (laboratory data for this soil are given in tables 9 and 10):

A1—0 to 3 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, thin and medium, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine roots; many very fine, fine, and medium vesicular pores; slightly effervescent; pH 8.6; abrupt, smooth boundary.

C1—3 to 13 inches, light-gray (10YR 7/2) fine sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few medium roots, and abundant very fine and fine roots; many very fine and fine tubular pores, and few medium tubular pores; slightly effervescent; pH 8.6, clear, smooth boundary.

C2—13 to 20 inches, very pale brown (10YR 7/3) fine sandy loam, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; abundant very fine and fine roots, and few medium roots; many very fine and fine tubular pores; slightly effervescent; pH 8.6; clear, wavy boundary.

C3—20 to 39 inches, very pale brown (10YR 7/3) fine sandy loam and a few thin lenses of silt loam, dark brown (10YR 4/3) when moist; massive, but with moderate, thin, platy lenses of silty material; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; abundant fine and very fine roots; many fine and very fine tubular pores; slightly effervescent; pH 8.6; abrupt, wavy boundary.

IIC4—39 to 45 inches, pale-brown (10YR 6/3) very gravelly sand (60 percent fine gravel), dark brown (10YR 4/3) when moist; single grain; loose when dry or moist; abundant very fine roots; many very fine and fine interstitial pores; slightly effervescent; pH 8.6; abrupt, smooth boundary.

IIIC5—45 to 57 inches, light-gray (10YR 7/2) loam, with a few, fine, faint, white (10YR 8/2) filaments of lime, dark brown (10YR 4/3) when moist; weak, thick and medium, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant fine and very fine tubular pores; slightly effervescent; pH 8.4; clear, smooth boundary.

IVC6—57 to 64 inches +, brown (10YR 5/3) fine gravelly coarse sandy loam (15 percent fine gravel), dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine and very fine roots; common fine and many very fine tubular pores; noneffervescent; pH 8.4.

The topmost 2 to 4 inches generally have a moderate or well-developed vesicular crust, but this may be lacking in areas where the A horizon is coarser textured than fine sandy loam. The texture of the profile is dominantly fine sandy loam or sandy loam, but minor stratification with very fine sandy loam, loam, or loamy fine sand occurs in some places. Below a depth of 36 inches, stratification is variable, and in places the profile includes strata of gravelly or very gravelly material. Fine or medium segregations of lime occur in some places below a depth of 30 inches.

These soils are well drained, have very slow or slow runoff, and are moderate or high in available water capacity. Their permeability generally is moderate, but it is very slow in places where the soil overlies cemented material. Natural fertility is high, and the root zone is very deep or deep. The hazard of erosion is slight or moderate.

The Fang soils have a cover of natural vegetation that provides limited grazing for livestock and habitat for upland wildlife. They are well suited to cultivated crops if water is made available for irrigation.

Fang fine sandy loam, 0 to 2 percent slopes (FaA).—This nearly level soil occurs on large, uniform alluvial fans, mostly south of State Route 25 in Penoyer Valley. The average slope is about 1 percent. The plant cover is mainly winterfat and fourwing saltbush, but there is a small amount of Indian ricegrass and galleta.

Included with this soil, around the base of scattered shrubs, are hummocks of fine sand or loamy fine sand. Also included are small areas in which the surface layer is gravelly. These inclusions make up about 3 percent of the total acreage.

This soil is used principally as range that provides limited grazing for livestock. It also is used as habitat for wildlife. On range managed for cattle, the most important plants are winterfat, fourwing saltbush, and Indian ricegrass. The soil can be leveled and irrigated if water is made available, but it is likely to blow unless protected. (Capability unit I–1, irrigated; VIIc–K, dryland)

Fang fine sandy loam, 2 to 4 percent slopes (FaB).—This soil lies on alluvial fans in Penoyer Valley, mainly south of Shadow Well. Slopes generally are smooth and average about 3 percent. In a few places there are shallow washes. Surface runoff is slow, and erosion is only a slight hazard. The plant cover consists mainly of winterfat and fourwing saltbush, together with a small amount of galleta and Indian ricegrass.

Included with this soil are large areas that are covered by 1 to 2 inches of loamy fine sand over the vesicular crust. Also, in places there are small sandy hummocks as much as 12 inches high around the base of shrubs. These inclusions make up about 15 percent of the total acreage.

This soil is in range that is grazed by livestock, but its use is limited. It also provides habitat for upland wildlife. On range managed for cattle, the most important plants are winterfat, fourwing saltbush, and Indian ricegrass. In areas where water is available, the soil can be developed for irrigation. (Capability unit IIe–1, irrigated; VIIc–K, dryland)

Fang gravelly fine sandy loam, overflow, 0 to 2 percent slopes (FgA).—This soil occurs in rather broad flood channels throughout the western side of Penoyer Valley. It is crossed by small, meandering drainage channels 1 to 2 feet deep. The slope is uniform and, on the average, is about 1 percent. This soil consists of gravelly fine sandy loam to a depth of 9 to 20 inches and, about 1 year in 10, is subject to overflow that causes little damage. Other than in texture, its profile is similar to that described as representative of the series. The gravel content in the uppermost 9 to 20 inches ranges from 20 to 30 percent. Surface runoff is very slow. Soil blowing is a moderate hazard. The vegetation consists of winterfat, fourwing saltbush, and some Indian ricegrass and galleta.

Included with this soil are small areas having cobblestones on the surface and, adjacent to drainage channels, small areas that are eroded. These inclusions make up less than 5 percent of the total acreage.

This soil is in range that is used for grazing by livestock, and it also provides habitat for upland wildlife. In areas where the range is managed for cattle, the most important plants are winterfat, fourwing saltbush, and Indian ricegrass. The soil can be developed as cropland if water is made available for irrigation, but it is likely to blow if left unprotected for a long time. In areas used for crops, dikes will be needed to protect crops and soil from damage by overflow. (Capability unit IIw–F, irrigated; VIIc–K, dryland)

Fang gravelly sandy loam, 2 to 4 percent slopes (FhB).—This soil occupies gently sloping alluvial fans north of Sand Spring. Except in places where a few deep drainage channels occur, the soil has a smooth surface and an average slope of about 3 percent. It is gravelly sandy loam to a depth of 6 to 12 inches, but in other respects its profile is similar to that described as representative of the series. The gravel content ranges from 20 to 40 percent. Surface runoff is slow, and the hazard of erosion is slight. The plant cover consists of shadscale, winterfat, bud sagebrush, and some galleta and Indian ricegrass.

Included with this soil are small areas in which the content of gravel is less than 15 percent. Also included are small areas where the gravel content is between 50 and 60 percent. These inclusions make up about 5 percent of the total acreage.

This soil provides limited grazing for livestock and habitat for upland wildlife. It can be leveled and irrigated if water is made available, but soil blowing is likely in areas that are left unprotected. On range managed for cattle, the most important plants are winterfat, galleta, shadscale, and bud sagebrush. (Capability unit IIe–1, irrigated; VIIc–K, dryland)

Fang loamy fine sand, 0 to 2 percent slopes (FlA).—This soil lies in a large, slightly undulating area south of State Route 25 in Penoyer Valley. The average slope is about 1 percent. Except for the loamy fine sand texture in the upper 4 to 9 inches, the profile is similar to the one described as representative of the series. Surface runoff is very slow, but soil blowing is a moderate hazard. The plant cover consists mainly of winterfat and fourwing saltbush, and there is some Indian ricegrass.

Included with this soil are areas in which the surface horizon of loamy fine sand is only ½ to 3 inches thick. If this horizon is mixed with the material just below it, the mixture is fine sandy loam. The inclusions make up less than 5 percent of the total acreage.

This soil is in range that provides limited grazing for livestock. In addition, it is used as habitat for upland wildlife. On range managed for cattle, the most valuable plants are winterfat, fourwing saltbush, and Indian ricegrass. If water is made available, the soil can be prepared for irrigation and used for crops. (Capability unit IIs–L, irrigated; VIIs–4, dryland)

Fang loamy fine sand, overblown, 0 to 2 percent slopes (FmA).—This soil occupies a series of terracelike ridges in the Penoyer Area. It lies east of, and slightly higher than, Fang loamy fine sand, 0 to 2 percent slopes. It consists of loamy fine sand to a depth of 6 to 20 inches, but otherwise its profile is similar to the one described as representative of the series. The loamy fine sand varies so much in thickness because, through wind action, it has been thinned in some places and built up in others. The average thickness of this material is about 10 inches. Surface runoff is very slow, but soil blowing is a moderate hazard. The vegetation is winterfat, fourwing saltbush, and a small amount of Indian ricegrass.

Included with this soil are small areas of a soil that is similar to this one but is moderately sloping or strongly sloping. These inclusions occupy short breaks, 10 to 20 feet wide, along terraces. They make up less than 5 percent of the total acreage.

This soil is in range that is used for limited grazing. It also is used as habitat for upland wildlife. On range managed for cattle, the most important plants are winterfat, fourwing, saltbush, and Indian ricegrass. Leveling is needed in areas prepared for irrigation, but 3- to 5-foot cuts can be avoided by leveling each terracelike ridge as a unit. To control blowing and damage to emerging seedlings, the soil should be kept moist until a plant cover is

established. (Capability unit IIs–L, irrigated; VIIs–4, dryland)

Fang sandy loam, 0 to 2 percent slopes (FnA).—This soil is extensive on broad alluvial fans north of Sand Spring in the Penoyer Area. Although the fans are dissected by a few washes 6 to 12 feet deep, they generally have a smooth surface and an average slope of about 1.5 percent. The soil consists of sandy loam to a depth of 18 to 25 inches, but in other respects its profile is similar to the one described as representative of the series. Surface runoff is very slow, the available water capacity is high, and the hazard of erosion is slight. The principal plants are shadscale, bud sagebrush, winterfat, and a small amount of galleta and Indian ricegrass.

Included with this soil are a few small ridges made up of sand that was deposited by wind and reworked by water. Also included, in some places, are small hummocks of sandy material that accumulated around the base of shrubs. In addition, there are patches in which the upper part of the soil is gravelly. These inclusions occupy only about 2 percent of the total acreage.

This soil is used for limited livestock grazing and for upland wildlife. The most important plants on range managed for cattle are winterfat, galleta, shadscale, and bud sagebrush. The soil can be leveled and used for irrigated crops if water is made available. Soil blowing is likely, however, if large areas are left unprotected. (Capability unit I–1, irrigated; VIIc–K, dryland)

Fang sandy loam, slightly saline-alkaline, 0 to 2 percent slopes (FpA).—This inextensive soil lies in a trough northeast of Sand Spring, where excess salts and alkali have accumulated in the A and upper C horizons. The soil is sandy loam between the surface and a depth of 5 to 11 inches, but in other respects it has a profile that is similar to the one described for the series. Runoff is very slow, the available water capacity is high, and the hazard of erosion is slight. Graymolly and shadscale are the principal plants.

Included with this soil are areas where the soil is free of excess salts and alkali in the topmost 2 to 5 inches but is slightly or moderately saline-alkali in the rest of the profile. These inclusions account for about 15 percent of the total acreage.

This soil is in range that provides limited grazing for livestock, and it is used as habitat for upland wildlife. In range areas managed for cattle, the most valuable plants are graymolly and shadscale. Irrigating this soil is feasible if water is made available. During the initial period of cultivation, however, only those crops that are tolerant of salts should be grown. (Capability unit I–1, irrigated; VIIs–6, dryland)

Fang sandy loam, deep, 2 to 4 percent slopes (FrB).—This soil occupies a large, gently sloping alluvial fan between Black Rock and the playa in Penoyer Valley. The general slope is about 2 percent, but there are side slopes of as much as 4 percent. Because of many shallow washes, the surface is slightly undulating. The soil material in the C3 and IIC4 horizons is hard when dry, and a white hardpan cemented with silica occurs below a depth of 40 inches. In other respects the profile is similar to that described for the series. Permeability in the hardpan is very slow, and the root zone in this soil is deep. Surface runoff is slow, the available water capacity is moderate, and the erosion hazard is moderate. Galleta, bud sagebrush, and shadscale make up the vegetation.

Included with this soil are gravelly spots where 20 to 40 percent of the surface is covered with pebbles. Also included, adjacent to washes, are small eroded areas in which there are many shallow rills. These inclusions account for about 3 percent of the total acreage.

This soil is in range that is used for limited grazing by livestock. It also provides habitat for upland wildlife. On range managed for cattle, the most important plants are winterfat, galleta, and shadscale. This soil can be leveled and irrigated if water is made available. For some crops, however, the root zone may be too shallow unless the depth of cuts made in leveling is less than 18 inches. To avoid a water table perched above the hardpan, irrigation water must be applied carefully. (Capability unit IIe–1, irrigated; VIIs–4, dryland)

Fang-Nyala association, 2 to 4 percent slopes (FsB).—This mapping unit occupies gently sloping alluvial fans northeast of Sand Spring. The fans are smooth or very gently convex, and the average slope is 3 percent. About 40 percent of the association is Fang fine sandy loam, 2 to 4 percent slopes; 40 percent is Nyala sandy loam, 2 to 4 percent slopes; and 20 percent is inclusions.

Fang fine sandy loam, a very deep soil, lies in broad areas that apparently are old drainageways dissecting the alluvial fans. Dominant in the plant cover on this soil are winterfat and fourwing saltbush, and there is a small amount of galleta and Indian ricegrass.

Nyala sandy loam occupies slightly higher positions on the alluvial fans. This soil has a profile that is similar to the one described under the heading "Nyala Series," but its A horizon ranges from 8 to 13 inches in thickness. Unlike the Fang soil, the Nyala soil has a sandy clay loam subsoil and, in the upper C horizon, contains nodules that are weakly cemented with silica. Galleta and bud sagebrush make up most of the plant cover, but there is some Indian ricegrass, shadscale, winterfat, and fourwing saltbush.

The inclusions are mainly scattered areas of gravelly Fang soils and gravelly Nyala soils. Also included, next to drainage channels, are small areas of eroded Nyala soils that have an A horizon only 4 to 7 inches thick.

The soils in this association are used as range that provides limited grazing for livestock and habitat for upland wildlife. If water is made available for irrigation, they can be developed as cropland. In range areas managed for cattle, the important plants are winterfat, fourwing saltbush, and Indian ricegrass on the Fang soil and winterfat, Indian ricegrass, galleta, and shadscale on the Nyala soil. (Fang soil: capability unit IIe–1, irrigated; VIIc–K, dryland. Nyala soil: capability unit IIe–1, irrigated; VIIs–4, dryland)

Geer Series

The Geer series consists of somewhat stratified, medium-textured soils on nearly level flood plains and toe slopes of alluvial fans in Pahranagat Valley. These soils formed in material derived from various kinds of rocks, including ignimbrite, basalt, and limestone, and in material eroded from old lake sediments of Tertiary age.

Representative profile of a Geer soil, located in a cultivated field about 300 feet east and 1,000 feet south of the northwest corner of section 14, T. 5 S., R. 60 E.:

Ap—0 to 14 inches, pale-brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant very fine, fine, and medium roots; many fine and medium tubular pores; strongly effervescent; pH 8.2; clear, smooth boundary.

C—14 to 60 inches +, very pale brown (10YR 7/3), stratified loam, very fine sandy loam, and silt loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; plentiful very fine and fine roots; common very fine and fine tubular pores; strongly effervescent; pH 8.2.

The texture throughout the profile is dominantly loam, silt loam, or very fine sandy loam, but in some places the profile includes strata of fine sandy loam or sandy loam. In areas where the water table is fairly high, faint reddish mottles of iron are few to common below a depth of 40 inches. Some fine or medium segregations of lime can occur in any strata below a depth of 20 inches. The reaction is moderately alkaline or strongly alkaline in irrigated areas, but it ranges from moderately alkaline to very strongly alkaline in nonirrigated areas. Some areas are affected by salts, most commonly where the water table is high.

Runoff is very slow on these moderately well drained and somewhat poorly drained soils. Permeability is moderate, and the available water capacity is high. The water table normally is 7 to 10 feet below the surface, but it may be within 3 feet of the surface in lower lying areas because of seepage from canals, springs, and seeps. Natural fertility in these soils is high, and the root zone is very deep. Erosion is a slight hazard.

In most areas the Geer soils are not irrigated, but they are used to provide limited grazing for livestock and habitat for upland wildlife. In some areas where irrigation water is available, the soils are used for alfalfa, small grain, and pasture.

Geer fine sandy loam (Ge).—This soil, the most extensive in the Geer series, occurs in fairly large areas throughout the Pahranagat Valley. Some of these areas are on toe slopes of alluvial fans, and others are on the nearly level flood plain. The average slope is about 1 percent. The A horizon of this soil is fine sandy loam and is 10 to 17 inches thick, but otherwise the profile is similar to the representative one described. On the average, the A horizon is about 12 inches thick, and it is not affected by excess soluble salts. The water table is 7 to 10 feet below the surface most of the year. Fourwing saltbush forms the vegetative cover. The plants are vigorous and grow in almost pure stands.

Less than 5 percent of the total acreage consists of included small areas of Geer fine sandy loam, slightly saline. If water were made available for irrigation, the slight salinity in these included areas would not limit the growing of cultivated crops.

This soil is in range that provides limited grazing for livestock and habitat for upland wildlife. It can be developed as irrigated cropland if water is made available, but leveling may be needed to prepare fields for irrigation. The most important plant on range managed for cattle is fourwing saltbush. (Capability unit I–1, irrigated; VIIc–K, dryland)

Geer fine sandy loam, slightly saline (Gf).—This nearly level soil occurs mostly in the lower Hiko and Ash Springs watershed, where the water table was higher in the past than it is now. Except for having an A horizon of fine sandy loam that is 10 to 17 inches thick and is slightly affected by excess salts, this soil is similar to the one described in the representative profile. The A horizon is very strongly alkaline, but the alkalinity decreases with depth. Although the water table now occurs at a depth ranging from 7 to 10 feet, the soil contains iron mottles below a depth of 40 inches. These mottles indicate that the lower part of the profile formerly was saturated with ground water. The vegetation consists of an almost pure stand of quailbush, together with some alkali sacaton.

About 10 percent of the total acreage consists of included small areas of Geer fine sandy loam that does not contain excess soluble salts in the surface horizon.

This soil is in range that is used for limited grazing and as habitat for upland wildlife. It can be leveled and used for irrigated crops if water is made available. During the initial period of cultivation, however, only those crops that are tolerant of salts should be grown. The most valuable plants on range managed for cattle are alkali sacaton and quailbush. (Capability unit I–1, irrigated; VIIs–6, dryland)

Geer fine sandy loam, water table, strongly saline (Gh).—This nearly level soil occupies small toe slopes of alluvial fans south of Alamo in the Pahranagat Valley. In most respects its profile is similar to the one described for the series, but the A horizon is 10 to 17 inches of fine sandy loam that is strongly affected by salts. In addition, this soil is somewhat poorly drained and has a high water table that fluctuates between the depths of 36 and 60 inches. The high water table is a result of seepage from canals and springs. Because of the high ground water, reddish iron mottles occur below a depth of 40 inches. The soil is very strongly alkaline in the A horizon and is strongly alkaline in the C horizon. The vegetation consists chiefly of quailbush, greasewood, rubber rabbitbrush, and seepweed, and there is an understory of inland saltgrass.

Included with this soil, and making up about 10 percent of the total acreage, are hummocks of wind-deposited material 1 to 3 feet high. In areas where these hummocks occur, preparing the soil for irrigation will be considerably more costly than in nonhummocky areas.

This soil generally is used to provide grazing for livestock and habitat for upland wildlife. On range managed for cattle, the most important plants are alkali sacaton, inland saltgrass, and quailbush. If water is made available for irrigation, this soil can be leveled and intensively cultivated. But only the grasses or grains most tolerant of saline conditions can be grown until the soluble salts can be leached with excess water. Thereafter, a favorable salt balance can be maintained if the soil is periodically overirrigated. (Capability unit IIw–2, irrigated; VIIw–6, dryland)

Geer silt loam (Gk).—This nearly level soil occurs in the vicinity of Alamo, where the water table once was high but has been lowered by constructing deep drains and lining the irrigation ditches. Now, the water table is 7

to 10 feet below the surface. The profile is similar to that described as representative of the Geer series. In areas of natural vegetation, fourwing saltbush grows vigorously and forms almost pure stands.

Included in areas mapped as this soil are small areas on nonirrigated Geer silt loam that are slightly affected by excess soluble salts.

Most of this soil is used for irrigated crops. The soil also provides habitat for upland wildlife. The principal crops are alfalfa and small grain, which are grown in rotation, and grasses and legumes used for pasture. (Capability unit I–1, irrigated; VIIc–K, dryland)

Geer silt loam, water table (Gl).—This soil occupies several areas on the nearly level flood plain between Brownie Spring and Hiko Spring in Pahranagat Valley. It is somewhat poorly drained. The water table generally is at a depth of about 54 inches during the growing season, but it rises to within 42 inches of the surface in winter. Reddish mottles and stains of iron occur below a depth of 40 inches.

Included with this soil are small areas in which the soil is slightly affected by salts. Crop yields are a little lower in these areas.

This soil is irrigated and is used for cultivated crops, principally alfalfa and small grain. It also furnishes habitat for upland wildlife. An occasional heavy irrigation may be needed to reduce the concentration of salts in the C horizon. (Capability unit IIw–2, irrigated)

Geer silt loam, water table, moderately saline (Gm).—This soil lies on the smooth, nearly level flood plain in the vicinity of Hiko Spring and Ash Springs. It has a profile similar to the one described as representative of the series, but it has a high water table and contains a moderate concentration of soluble salts. The water table occurs at a depth of 48 to 60 inches during most of the irrigation season, but it is within 36 inches of the surface in winter. In some places there are a few reddish mottles of iron below a depth of 40 inches. The A horizon is very strongly alkaline, and the C horizon is strongly alkaline. Quailbush, rubber rabbitbrush, and greasewood are the dominant shrubs, and there is an understory of inland saltgrass and sedges.

Included with this soil are small, low-lying areas that occasionally receive surplus irrigation water and are only slightly affected by salts. Also included are small, slightly higher areas that are strongly saline because they contain salts that accumulated through the rise and evaporation of saline ground water. These inclusions make up less than 10 percent of the total acreage.

This soil is used to provide grazing for livestock and habitat for upland wildlife. In grazing areas managed for cattle, the most valuable plants are alkali sacaton, inland saltgrass, and quailbush. If water is made available, the soil can be leveled and irrigated, but only salt-tolerant crops can be grown until the content of soluble salts is reduced. (Capability unit IIw–2, irrigated; VIIw–6, dryland)

Geer silt loam, water table, slightly saline (Gn).—This nearly level soil occurs in scattered areas north of Alamo. Here, it is slightly affected by soluble salts and has a water table that fluctuates between the depths of 48 and 60 inches. It is strongly alkaline throughout the profile. The natural vegetation is an almost pure stand of quailbush, but there is a variable amount of alkali sacaton.

Included with this soil are small mounds and ridges in which the soil is moderately or strongly affected by salts. These inclusions make up about 5 percent of the total acreage.

This soil is used mainly for livestock grazing and as habitat for upland wildlife. If water is made available, the soil can be irrigated but may require some leveling. During the initial period of cultivation, only those crops that are tolerant of salts should be grown. In grazing areas managed for cattle, the most valuable plants are alkali sacaton and quailbush. (Capability unit IIw–2, irrigated; VIIw–6, dryland)

Jarboe Series

The Jarboe series consists of nearly level soils that are affected by salts and alkali. These soils are moderately coarse textured in the A1 and C1 horizons but are moderately fine textured below them. They formed in lake-deposited material derived from limestone, sandstone, shale, tuff, andesite, and basalt. They have been modified by calcium carbonate that was precipitated from evaporating ground water, and they contain a hardpan strongly cemented with lime. The Jarboe soils lie in shallow basins and on smooth terraces on the floor of Penoyer Valley.

These soils were more poorly drained in the past than they are today. As the lake water evaporated, the water table was lowered and natural drainage was improved. When the soils were more poorly drained, they supported little or no vegetation.

Representative profile of a Jarboe soil, located about 630 feet south and 950 feet west of the east quarter corner of section 26, T. 3 S., R. 55 E.:

A1—0 to 3 inches, light-gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) when moist; strong, thin to medium, platy structure; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; very few fine and medium roots; many fine and medium vesicular pores; strongly effervescent; pH 8.7; abrupt, smooth boundary.

C1—3 to 6 inches, horizon similar to A1 horizon in color and texture; weak, medium, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few fine and medium roots; many fine vesicular pores; violently effervescent; pH 9.2; clear, wavy boundary.

C2ca—6 to 13 inches, white to very pale brown (10YR 8/1 to 8/4) marly silty clay loam, light gray to very pale brown (10YR 7/2 to 7/4) when moist; strong, medium to fine, subangular blocky structure; extremely hard when dry, firm to very firm when moist, sticky and plastic when wet; plentiful fine, medium, and coarse roots; many cracks between aggregates; violently effervescent; pH 8.7; clear, irregular boundary.

C3cam—13 to 23 inches, white (10YR 8/1), strongly lime cemented hardpan, except on fracture planes where it is very pale brown (10YR 8/3 or 8/4) marly silty clay loam that contains many conch shells about 1 millimeter long and ¼ millimeter in diameter; white 10YR 8/2) when moist, except on fracture planes, which are very pale brown (10YR 7/3 to 8/4); massive; very few fine roots in cracks between aggregates; no visible pores; violently effervescent; pH 8.9; clear, irregular boundary.

C4g—23 to 66 inches +, white (5Y 8/1 or 8/2) silt loam, light gray (5Y 7/2) when moist; few, fine, distinct, light yellowish-brown (10YR 6/4) and reddish-brown mottles (5YR 4/4) caused by oxidation of iron; massive (structureless) or weak, thin, platy structure; very hard when dry, firm when moist, nonsticky and slightly plastic when wet; few or no roots; common fine tubular pores; violently effervescent; pH 9.

The depth to the hardpan ranges from 10 to 20 inches, and thickness of the hardpan ranges from 7 to 24 inches. The C2ca horizon is silty clay loam or heavy silt loam. Concentrations of excess salts and alkali in these soils range from slight to strong.

Natural drainage is moderately good in the Jarboe soils. Runoff is very slow, permeability is very slow, and the available water capacity is very low. The soils are low in natural fertility and have a shallow root zone. They are slightly susceptible to erosion.

The only use made of the Jarboe soils is limited grazing by livestock.

Jarboe sandy loam, saline-alkali (Ja).—This soil occupies positions above other Jarboe soils around the playa in Penoyer Valley. It contains only a slight concentration of salts and alkali in the A1 and C1 horizons, but it is strongly saline-alkali in the lower horizons. Fourwing saltbush makes up most of the plant cover, though greasewood and graymolly also occur.

Included with this soil are areas moderately affected by salts and alkali. Runoff from higher lying soils floods these areas about 1 year in 10. Also included are small, barren basins that resemble playas. The inclusions account for about 15 percent of the total acreage.

This soil is in range that provides limited grazing for livestock. It is not suitable for intensive cultivation or for irrigation, because the root zone is shallow and the available water capacity is very low. On range managed for cattle, the most important plants are fourwing saltbush and graymolly. (Capability unit VIIs-6, dryland)

Jarboe very fine sandy loam, strongly saline-alkali (Jb).—This soil occupies a large area along the northwestern edge of the playa in Penoyer Valley. The A1 and C1 horizons consist of very fine sandy loam that is strongly affected by salts and alkali, but in other respects the profile is similar to the one described as representative of the series. In years of extremely high runoff—about 1 year in 20—this soil is flooded when the playa lake rises and expands. The vegetation consists mainly of greasewood, and there is some fourwing saltbush and graymolly.

Included are several areas of Kawich fine sand, a soil that lies in large dunes, some of which are as much as 100 feet long and 10 to 12 feet high. Also included are a few sandy ridges extending from nearby alluvial fans, and some barren spots resembling playas. These inclusions make up slightly less than 15 percent of the total acreage.

This soil is in range, but it provides little grazing for livestock. It is not suitable for cultivation or for irrigation, because the available water capacity is very low, the root zone is shallow, and the concentrations of salts and alkali are strong. The most important plants on range managed for cattle are fourwing saltbush and graymolly. (Capability unit VIIs-6, dryland)

Kawich Series

The Kawich series consists of coarse-textured soils that developed in windblown material derived mainly from tuff, limestone, dolomite, quartzite, shale, and sandstone. These soils occur in semistabilized dunes on the playa in Penoyer Valley. The dunes are 4 to 15 feet high.

Representative profile of a Kawich soil, located about 300 feet west of the northeast corner of section 26, T. 3 S., R. 55 E.:

A1—0 to 2 inches, very pale brown (10YR 7/3) slightly loamy fine sand or fine sand, brown (10YR 5/3) when moist; single grain; loose when dry or moist; few very fine and fine roots; many micro and very fine interstitial pores; violently effervescent; pH 8.7; clear, smooth boundary.

C1—2 to 10 inches, very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) when moist; single grain; loose when dry or moist; few, medium and abundant, very fine and fine roots; many micro and very fine interstitial pores; violently effervescent; pH 8.7; gradual, smooth boundary.

C2—10 to 46 inches, very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) when moist; single grain; loose when dry or moist; few medium roots, and abundant very fine and fine roots; many micro and very fine interstitial pores; violently effervescent; pH 8.4; abrupt, smooth boundary.

IIC3—46 to 48 inches +, very pale brown (10YR 7/4) light silty clay loam, yellowish brown (10YR 5/4) when moist; strong, thin, platy structure; hard when dry, friable when moist, sticky and plastic when wet; few very fine and fine roots; many very fine and fine vesicular pores, and few very fine tubular pores; violently effervescent; pH 8.9.

The depth to finer textured soil material (IIC3 horizon) ranges from about 38 inches to more than 120 inches. This soil material is similar to the material in the playa itself. The lower lying dunes that are shallower to playa material have been slightly or moderately affected by salts that were brought into the dunes by laterally moving floodwater. In some places salt crystals occur in horizons above the finer textured material. The reaction ranges from moderately alkaline to very strongly alkaline.

These excessively drained soils have very slow runoff, are rapidly permeable, and have very low or low available water capacity. Their natural fertility is low, and their root zone is very deep. Soil blowing is a severe hazard.

All areas of Kawich soils are in range that is used for limited grazing.

Kawich-Playa complex (Kp).—This extensive mapping unit lies in the trough of Penoyer Valley. On the western side it consists of many small to large dunes and areas of barren Playa. Toward the east the dunes decrease in size and number, and all of the valley floor is Playa. The vegetation on the Kawich soil is mainly greasewood and seepweed on the smaller dunes adjacent to the playa, and it is fourwing saltbush, graymolly, and shadscale on the larger dunes. The Playa is practically bare, though a few seepweed and greasewood plants grow along the margin.

About 45 percent of the complex is Kawich fine sand, 0 to 12 percent slopes; 45 percent is Playa, a land type; and 10 percent is included small areas of other soils.

Kawich fine sand is a deep or very deep, nearly level to strongly sloping soil that occurs in rolling, semi-

stabilized dunes. Level deposits of fine-textured material make up the Playa. These deposits are periodically covered with water, and they are strongly affected by salts and alkali.

Included in areas mapped as this complex, on low and undulating terraces adjacent to the Playa, is shallow or moderately deep sandy material over clayey material. This material is slightly or moderately affected by salts and alkali, and the salts take up and hold so much moisture that the soil appears saturated. Although it supports a few greasewood plants, about 99 percent of the surface is bare.

The Kawich soil in this complex is used as range that provides forage for livestock. Because it occupies rolling dunes and is highly susceptible to blowing, it is not suitable for cultivation and irrigation. On range managed for cattle, the most important plants are fourwing saltbush, Indian ricegrass, and shadscale. No use is made of the Playa. (Kawich soil: capability unit VIIs-L, dryland; Playa: capability unit VIIIw-F, dryland)

Koyen Series

The Koyen series consists of moderately coarse textured soils that formed in alluvium derived from basalt and tuff. These soils are on smooth, gently sloping alluvial fans in Penoyer Valley.

Representative profile of a Koyen soil, located about 1,800 feet south and 500 feet west of the north quarter corner of section 14, T. 3 S., R. 54 E.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine and fine roots; many very fine and fine vesicular pores; noneffervescent; pH 8.6; abrupt, smooth boundary.

B2—3 to 7 inches, light brownish-gray (10YR 6/2) sandy loam, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many micro and very fine interstitial pores, and common very fine and fine tubular pores; noneffervescent; pH 8.6; clear, smooth boundary.

B3—7 to 17 inches, light grayish-brown (10YR 6/2) sandy loam (15 percent gravel), dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many micro and very fine interstitial pores, and common very fine and fine tubular pores; slightly effervescent, with a few, fine, distinct filaments of white lime; pH 8.6; clear, smooth boundary.

C1—17 to 34 inches, light-gray (10YR 7/2) sandy loam and a few strata, 1 to 1½ inches thick, that contain 10 percent fine gravel, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine roots, and abundant very fine roots; many very fine and fine tubular pores, and many micro and very fine interstitial pores; strongly effervescent; pH 8.6; abrupt, smooth boundary.

C2ca—34 to 44 inches, white (10YR 8/2) sandy loam, yellowish brown (10YR 5/4) when moist; a few, fine, distinct, light-brown (7.5YR 6/4) and brown (7.5YR 5/4) iron mottles; moderate, thick, platy structure in the upper 1 inch, massive below; hard when dry, firm when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; common very fine and fine tubular pores; many very fine cracks between plates; violently effervescent; pH 9.0; clear, irregular boundary.

IIC3—44 to 63 inches +, light-gray (10YR 7/2) gravelly loamy sand (30 to 40 percent fine gravel), brown (10YR 5/3) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine and fine roots; many very fine and fine interstitial pores; violently effervescent; pH 8.5.

In the uppermost 2 to 4 inches, there is a moderately developed vesicular crust. The profile is dominantly sandy loam, but in places it includes strata of fine sandy loam, loam, or coarse loamy sand. Some of these strata are gravelly, their content of gravel ranging as high as 40 percent. The depth to the C2ca horizon is 21 to 36 inches. The reaction is moderately alkaline to strongly alkaline.

These soils are well drained. They have very slow runoff, moderately rapid permeability, and moderate available water capacity. Their natural fertility is moderate, and their root zone is very deep. Erosion is a moderate hazard.

The Koyen soils are in range, but their use for grazing is limited. These soils are suited to all crops that are suited to the climate, and they can be irrigated if water is made available.

Koyen sandy loam, 2 to 4 percent slopes (KsB).—This soil is in a large area on the smooth, gently sloping alluvial fan near State Route 25 in the southwestern part of Penoyer Valley. The surface generally is smooth, but under scattered shrubs there are hummocks of sandy material 2 to 8 inches high. Galleta, spiny hopsage, and littleleaf horsebrush make up most of the plant cover, along with some Indian ricegrass, winterfat, and bud sagebrush.

Included with this soil are a few, scattered, cobbly and gravelly spots. Also included are several, small, eroded areas that are crossed by many drainage channels 2 to 4 feet deep, and also a few shallower ones. These inclusions account for less than 3 percent of the total acreage.

This soil is used for range, irrigated pasture, and habitat for upland wildlife. It can be leveled and used for irrigated crops in areas where water is available. On range managed for cattle, the most important plants are galleta, Indian ricegrass, winterfat, and desert needlegrass. (Capability unit IIe-1, irrigated; VIIs-4 dryland)

Koyen-Tickapoo association, 2 to 4 percent slopes (KtB).—This association occurs on gently sloping alluvial fans south of Black Rock near State Route 25 in Penoyer Valley. It has smooth relief and an average slope of about 3 percent. The vegetation consists mainly of spiny hopsage, winterfat, Anderson wolfberry, galleta, bud sagebrush, and littleleaf horsebrush.

About 45 percent of the association is Koyen sandy loam, 2 to 4 percent slopes; 45 percent is Tickapoo sandy loam, 2 to 4 percent slopes; and 10 percent is small included areas of other soils.

Koyen sandy loam lies in somewhat depressional areas on the alluvial fans. It is dominantly moderately coarse textured throughout, and it contains accumulations of lime in the B and C horizons.

Tickapoo sandy loam occupies positions slightly above those of the Koyen soil. In contrast to the Koyen soil, it is fine textured in the B21t and B22t horizons, and it contains strata in the C horizon that are weakly to strongly cemented with silica and lime.

Included in areas mapped as these soils are areas in which the surface horizon is gravelly. These gravelly inclusions are scattered, and most of them consist of Tickapoo soil. Also included, in drainage channels, are small areas of Fang soils.

The soils in this association are used to provide limited grazing for livestock. They could be developed as cropland if water were made available for irrigation. On range managed for cattle, the important plants include Indian ricegrass, galleta, and desert needlegrass. Also, winterfat is an important plant in areas of Koyen soil used as range. (Koyen soil: capability unit IIe-1, irrigated; VIIs-4, dryland. Tickapoo soil: capability unit IIIe-3, irrigated; VIIs-4, dryland)

Lahontan Series, Water Table Variants

These variants from the normal Lahontan soils are nearly level or gently sloping, moderately fine textured, and somewhat stratified. They have a high water table and are affected by salts and alkali. These soils occupy flood plains and the adjacent toe slopes of alluvial fans in the southern part of Pahranagat Valley. They developed in material derived from various kinds of rock, including ignimbrite and limestone, and in eroded alluvial sediments of the Quaternary geologic period.

Representative profile of a Lahontan soil, water table variant, located about 800 feet north and 600 feet east of the southwest corner of section 4, T. 10 S., R. 62 E.:

A1—0 to 3 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; weak, medium to thick, platy structure; hard when dry, friable when moist, sticky and slightly plastic when wet; a few very fine and fine roots, and a few medium rhizomes; many fine and medium vesicular pores; violently effervescent; pH 9.6+; clear, smooth boundary.

C1—3 to 14 inches, very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) when moist; massive; hard to very hard when dry, firm when moist, sticky and plastic when wet; abundant very fine and fine roots, and abundant medium rhizomes; many fine vesicular pores; violently effervescent; pH 9.6; abrupt, wavy boundary.

IIC2—14 to 19 inches, very pale brown (10YR 7/3) very fine sandy loam, pale brown (10YR 6/3) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; few fine roots, few medium rhizomes, and abundant very fine roots; many fine and very fine tubular pores; strongly effervescent; pH 9.6; clear, smooth boundary.

IIIC3—19 to 41 inches, very pale brown (10YR 8/3) silty clay loam, pale brown (10YR 6/3) when moist; weak, thick, platy structure; very hard when dry, firm when moist, sticky and plastic when wet; plentiful fine and very fine roots; fine and very fine tubular pores; violently effervescent; pH 9.5; clear, smooth boundary.

C4—41 to 58 inches, very pale brown (10YR 8/3) silty clay loam, pale brown (10YR 6/3) when moist; weak, thick, platy structure; very hard when dry, firm when moist, sticky and plastic when wet; few very fine and fine roots; very few fine and very fine tubular pores; few, medium to coarse, faint mottles and splotches of light brownish-gray (10YR 6/2) lime, and many, fine, distinct, reddish-brown (5YR 5/4) mottles caused by oxidation of iron; strongly effervescent; pH 8.6; clear, wavy boundary.

C5—58 to 62 inches +, white (2.5Y 8/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, thick, platy structure; hard when dry, friable when moist, slightly sticky and plastic when wet; practically no pores or roots; violently effervescent; pH 8.2.

At all depths, these soils are dominantly silty clay loam or heavy silt loam. They are commonly stratified, however, with thin layers of very fine sandy loam, fine sandy loam, or light silty clay. These layers are less than 16 inches thick. Reddish or yellowish iron mottles occur in any strata below a depth of 30 inches. An excessive amount of molybdenum is present in some areas.

These poorly drained and somewhat poorly drained soils have slow runoff, slow permeability, and high available water capacity. They are high in natural fertility and have a very deep root zone. The hazard of erosion is slight. The water table fluctuates between depths of 18 and 42 inches, but normally it is highest in winter.

Most areas of these soils are irrigated and are used as cropland or for irrigated pasture of inland saltgrass. Molybdenum toxicity in livestock may be a problem in areas where clover is grazed.

Lahontan fine sandy loam, water table variant, 0 to 2 percent slopes (LaA).—This soil lies on nearly level toe slopes of alluvial fans near Black Canyon in Pahranagat Valley. It is somewhat poorly drained and, to a depth of 10 to 15 inches, consists of fine sandy loam that is slightly affected by salts. In other respects its profile is similar to that described as representative.

The water table fluctuates between the depths of 30 and 40 inches, and it is highest in winter. The A1 horizon is strongly alkaline, but the alkalinity decreases with depth.

Included are small areas in which the soil is free of excess salts. These inclusions make up about 15 percent of the total acreage.

This soil is irrigated and is used for alfalfa grown in rotation with small grain. It also is used for improved pasture and as habitat for wildlife. (Capability unit IIw-69, irrigated)

Lahontan fine sandy loam, water table variant, 2 to 4 percent slopes (LaB).—This soil lies south of Alamo and is on several, small, gently sloping alluvial fans, where the average slope is 3 percent. It is fine sandy loam in the uppermost 10 to 15 inches, is somewhat poorly drained, and is slightly affected by salts. Otherwise, it has a profile that is similar to the one described for the Lahontan series, water table variant. The water table, which is highest in winter, fluctuates from 30 to 42 inches below the surface. The reaction is strongly alkaline in the A1 horizon, but it decreases with depth.

Irrigated crops, improved pasture, and habitat for upland wildlife are the uses made of this soil. In fields used for crops, alfalfa is grown in rotation with small grain. (Capability unit IIIw-136, irrigated)

Lahontan silt loam, water table variant, 0 to 2 percent slopes (LhA).—This soil occurs on the nearly level flood plain in Pahranagat Valley, mostly south of Pahranagat Lakes. In the upper horizons it is slightly affected by excess soluble salts and is very strongly alkaline. The soil is poorly drained, and the water table fluctuates between the depths of 18 and 30 inches throughout the year.

Included with this soil are shallow depressions in which the water table is at or near the surface and the soil is very poorly drained. Also included are small mounds or ridges where the concentration of salts is strong. These inclusions occupy about 14 percent of the total acreage.

In most places this soil is irrigated and used for unimproved pasture made up of inland saltgrass. It can be leveled and used for irrigated crops or grass-legume pasture. In areas of natural vegetation managed for cattle, the most important plants are alkali sacaton and inland saltgrass. (Capability unit IVw-369P, irrigated)

Lahontan silt loam, water table variant, 2 to 4 percent slopes (LhB).—This somewhat poorly drained soil is on gently sloping alluvial fans between Alamo and Pahranagat Lakes. In this soil the water table fluctuates between the depths of 30 and 42 inches. The upper horizons are strongly alkaline and contain a slight concentration of soluble salts. The average slope is about 3 percent.

Included with this soil are areas in which the A1 horizon is free of salts. Also included, in nonirrigated areas, are hummocks that contain a strong concentration of salts. These inclusions account for less than 10 percent of the total acreage.

This soil is used mainly for unimproved meadow under irrigation and for upland wildlife. It is suitable for improved pasture and for irrigated crops, such as alfalfa grown in rotation with small grain. About a fourth of the acreage is used as irrigated cropland. In areas where the natural vegetation is managed for cattle, the most important plants are alkali sacaton and inland saltgrass. (Capability unit IIIw-136, irrigated)

Lahontan silt loam, water table variant, moderately saline, 0 to 2 percent slopes (LmA).—This soil is on the nearly level flood plain between Maynard and Lower Pahranagat Lake. It contains a moderate concentration of salts in the surface horizon and is poorly drained. The water table stays high because seepage from Lower Pahranagat Lake feeds the ground water. It fluctuates between depths of 18 and 30 inches most of the year. The upper horizons are very strongly alkaline.

About 10 percent of the total acreage consists of included slight ridges where the concentration of salts is strong.

Most of this soil is covered with inland saltgrass that is irrigated and pastured. In addition, the soil is used to some extent as habitat for wildlife. It is not suitable for intensive cropping, because the removal of excess salts is too difficult. In areas of natural vegetation managed for cattle, the most important plants are alkali sacaton and inland saltgrass. (Capability unit VIw-6, irrigated)

Lahontan Series, Poorly Drained Variants

The poorly drained variants from the normal Lahontan soils are fine-textured soils that are strongly affected by salts and alkali. These soils developed in sediments derived from various kinds of rock, including ignimbrite and limestone, and in Quaternary lake deposits. They occur in level areas and in slight depressions on the comparatively narrow flood plain at the lower end of Pahranagat Valley.

Representative profile of a Lahontan soil, poorly drained variant, located about 700 feet north and 400 feet west of the southeast corner of section 3, T. 10 S., R. 62 E.:

A1—0 to 1 inch, very pale brown (10YR 8/3) silty clay, brown (10YR 5/3) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; abundant very fine and fine roots; common very fine and fine interstitial pores; violently effervescent; pH 8.8; abrupt, smooth boundary.

C1—1 to 4 inches, light-gray (10YR 7/2) silty clay, brown (10YR 5/3) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; abundant very fine and fine roots; common very fine and fine tubular pores; few fine mollusk shells; violently effervescent; pH 8.8; clear, smooth boundary.

C2—4 to 10 inches, light-gray (10YR 7/2) silty clay, brown (10YR 5/3) when moist; massive; hard when dry, firm when moist, very sticky and very plastic when wet; plentiful very fine and fine roots; few fine and very fine tubular pores; few fine mollusk shells; violently effervescent; pH 8.6; abrupt, wavy boundary.

C3—10 to 24 inches, similar to C2 horizon in color, texture, structure, and consistence; few fine roots; many micro interstitial pores, and few very fine tubular pores; violently effervescent; pH 8.6; abrupt, wavy boundary.

C4—24 to 36 inches +, light-gray (2.5Y 7/2) silty clay, grayish brown (2.5Y 5/2) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; very few, very fine roots; very few, very fine tubular pores; few to common fine mollusk shells; violently effervescent; pH 8.6.

The texture in these soils is dominantly silty clay, but in some places the profile includes strata of silty clay loam or clay and thin strata of silt loam, very fine sandy loam, or fine sandy loam. In places there are olive-colored iron mottles below a depth of 20 inches. The concentration of alkali decreases with depth, and the content of salts is variable but is strong in some part of the profile above the water table. Shells of fresh-water mollusks are common throughout. The reaction is strongly alkaline or very strongly alkaline.

These soils are poorly drained and have very slow runoff and permeability. Their available water capacity and natural fertility are high, and their root zone is very deep. Erosion is a slight hazard.

Lahontan silty clay, poorly drained variant (Ln).—This soil lies in level areas or shallow basins at the southern end of Pahranagat Valley. The vegetation is mainly inland saltgrass, but there is some alkali sacaton, seepweed, and fourwing saltbush. The density of these plants depends on the salt and alkali content in the upper horizons.

Included are areas of a soil that is similar to this one but is silt loam to a depth of 6 to 12 inches and is slightly affected by salts and alkali. The included soil occupies slightly raised, nearly level areas near Maynard Lake. Also included is part of the lakebed that is covered with water only in years of high runoff. These inclusions make up about 25 percent of the total acreage. They are used and managed in much the same way as this Lahontan soil.

This soil is used for irrigated pasture of native plants and as habitat for migratory wildlife. It is not suitable for cultivation, because drainage is poor, permeability is very slow, and the concentrations of salts and alkali generally are strong. The most important plants in areas managed for cattle are alkali sacaton and inland saltgrass. (Capability unit VIw-6, irrigated)

Leo Series

In the Leo series are very gravelly soils that developed in alluvium derived from tuff and basalt. These soils are

on smooth, gently sloping to strongly sloping alluvial fans on the western side of Penoyer Valley.

Representative profile of a Leo soil, located about 950 feet north and 630 feet east of the south quarter corner of section 27, T. 2 S., R. 54 E.:

A1—0 to 6 inches, light brownish-gray (10YR 6/2) gravelly sandy loam (50 percent gravel), dark grayish brown (10YR 4/2) when moist; weak, medium, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine roots, and few fine and medium roots; many very fine and fine vesicular pores, and many very fine interstitial pores; noneffervescent; pH 8.6; clear, smooth boundary.

C1—6 to 16 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine tubular pores, and many micro and very fine interstitial pores; slightly effervescent; pH 8.6; clear, wavy boundary.

C2—16 to 29 inches, light brownish-gray (10YR 6/2) fine gravel, dark brown (10YR 4/3) when moist; single grain; loose when dry or moist; few medium roots, and abundant very fine and fine roots; many very fine and fine interstitial pores; slightly effervescent; pH 8.6; abrupt, smooth boundary.

C3—29 to 54 inches +, light brownish-gray (10YR 6/2) strata of gravelly loamy sand (30 percent gravel) and fine gravel, dark brown (10YR 4/3) when moist; massive and single grain; soft and loose when dry, very friable and loose when moist, nonsticky and nonplastic when wet; plentiful fine and abundant very fine roots; many very fine and fine interstitial pores; slightly effervescent; pH 8.6.

Leo soils are stratified and contain strata of loamy sand, loamy fine sand, sandy loam, and fine sandy loam in which the gravel content ranges from 10 to 80 percent. In some places there are strata of fine gravel. If the horizons in these soils were mixed, the texture throughout the profile would be very gravelly loamy sand. The content of gravel in the mixture would range from 50 to 70 percent. Tuff bedrock can occur at any depth below 30 inches. The reaction is moderately alkaline or strongly alkaline.

These soils are somewhat excessively drained and have slow runoff. Their permeability is rapid, and their available water capacity is low. Although the root zone is deep or very deep, natural fertility is low. The hazard of erosion is moderate.

The Leo soils are in natural stands of grasses and shrubs that provide limited grazing for livestock. They are not suitable for cultivation or for irrigation.

Leo extremely rocky sandy loam, 2 to 12 percent slopes (LrC).—This mapping unit occurs on gently sloping to strongly sloping alluvial fans and nearby foothills in the west-central part of the Penoyer Area. It occupies an irregularly shaped area in which tracts of accessible, low-lying, exposed tuff bedrock are intermingled with tracts of Leo gravelly sandy loam in about equal proportions. The soil has a profile that is similar to the one described for the series. Its root zone is deep, for unconformable bedrock lies at a depth of more than 30 inches. Although the exposed rock is nearly bare, the soil is in stands of galleta, Indian ricegrass, spiny hopsage, Mormon-tea, littleleaf horsebrush, and some bud sagebrush and winterfat.

Included with this mapping unit, adjacent to outcrops of rock, are areas that are stony and cobbly. These inclusions make up about 10 percent of the total acreage.

The soil in this unit provides limited grazing for livestock. It occurs with rock outcrops in such intricate patterns that it is not suitable for irrigation or cultivation. On range managed for cattle, the most important plants are Indian ricegrass, winterfat, desert needlegrass, and galleta. (Capability unit VIIs-7, dryland)

Leo gravelly sandy loam, 2 to 12 percent slopes (LsC).—This soil is on gently sloping to strongly sloping alluvial fans on the western side of the Penoyer Area. The relief is generally smooth, though it is rolling in many small areas that are crossed by drainage channels. The root zone is very deep. Covering the soil is a sparse stand of galleta, spiny hopsage, Mormon-tea, and littleleaf horsebrush, together with Indian ricegrass, bud sagebrush, and winterfat.

Included with this soil are small outcrops of tuff bedrock and adjacent stony and cobbly areas; spots next to drainage channels that are eroded and subject to occasional overflow; and small nongravelly areas. These inclusions make up about 10 percent of the total acreage.

This soil is in range that provides limited grazing for livestock. It is not suitable for cropping under irrigation, because of its uneven relief and low available water capacity. On range managed for cattle, the most valuable plants are galleta, Indian ricegrass, winterfat, and desert needlegrass. (Capability unit VIIs-4, dryland)

Maynard Lake Series

The Maynard Lake series consists of coarse-textured soils that formed in alluvium derived mainly from ignimbrite but partly from dolomite, limestone, quartzite, and basalt. These nearly level to strongly sloping soils are on recent, small alluvial fans and narrow flood plains in Pahranagat Valley.

Representative profile of a Maynard Lake soil, located about 800 feet west and 1,200 feet south of the northeast corner of section 3, T. 5 S., R. 60 E.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) gravelly loamy sand (45 percent gravel), dark grayish brown (10YR 4/2) when moist; single grain; loose when dry or moist; practically devoid of roots; many very fine and fine interstitial pores; strongly effervescent; pH 8.6; abrupt, smooth boundary.

C1—3 to 9 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few fine and very fine roots; many very fine and fine interstitial pores; strongly effervescent; pH 8.6; abrupt, smooth boundary.

C2—9 to 20 inches, light brownish-gray (10YR 6/2) loamy sand, dark brown (10YR 4/3) when moist; single grain; loose when dry or moist; few very fine and fine roots; many very fine and fine interstitial pores; strongly effervescent; pH 8.6; abrupt, wavy boundary.

C3—20 to 42 inches, light brownish-gray (10YR 6/2) loamy sand, dark brown (10YR 4/2) when moist; massive but breaks readily to single grains; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine roots; many very fine and fine interstitial pores; strongly effervescent; pH 8.6; abrupt, wavy boundary.

C4—42 to 52 inches +, light brownish-gray (10YR 6/2) gravelly loamy sand, dark brown (10YR 4/3) when moist; massive but breaks readily to single grains; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few fine and very fine roots; many very fine, fine, and medium interstitial pores; strongly effervescent; pH 8.6.

The gravel content in any one horizon ranges from 0 to 70 percent. If all the horizons were mixed, however, the mixture would rarely be more than 30 percent gravel. In a few places there are strata of loamy fine sand, sand, or fine sand. The content of lime varies widely. The reaction is moderately alkaline or strongly alkaline.

These soils are somewhat excessively drained and have very slow runoff, rapid permeability, and low available water capacity. They are low in natural fertility. The root zone is very deep. Erosion is a moderate hazard.

The main use of the Maynard Lake soils is limited livestock grazing. In fields where water is available for irrigation, the soils are used for alfalfa and small grain.

Maynard Lake gravelly soils, 4 to 12 percent slopes (MkC).—These are the most extensive Maynard Lake soils in Pahranagat Valley. They occur on many small alluvial fans and narrow flood plains. Their average slope is about 7 percent. The upper part of the profile is 6 to 14 inches of gravelly loamy sand or gravelly sandy loam, but in other respects the soils are similar to the one described as representative of the series. In the upper 6- to 14-inch layer, the gravel content ranges from 20 to 40 percent. The vegetation consists mainly of creosotebush, white bur-sage, shadscale, and white burrobrush. In addition, the plant cover contains spiny hopsage, Anderson wolfberry, and blackbrush at the higher elevations.

Included with this soil are small areas having slopes of 0 to 4 percent. These areas lie near the ends of alluvial fans, where the fans merge with the flood plain, and some of them are slightly or moderately affected by salts. Also included, along channels of intermittent streams at the higher elevations, are areas that are cobbly or stony. Inclusions account for about 5 percent of the total acreage.

These soils are used to provide limited grazing for livestock and habitat for upland wildlife. They are not suitable for cultivation or for irrigation, because slopes are too strong and the areas are too small. On range managed for cattle, the most important plants are shadscale and galleta. (Capability unit VIIs-L, dryland)

Maynard Lake loamy sand, 0 to 4 percent slopes (MlB).—This nearly level to gently sloping soil occupies smooth toe slopes of alluvial fans between Maynard Lake and Lower Pahranagat Lake. The average slope generally is 3 percent, but it is only 1 percent in an area about 2 miles north of Alamo. Except for the nongravelly surface horizon, the profile of this soil is similar to the one described as representative of the series.

About 10 percent of the total acreage consists of small included areas that are gravelly. Here, from 15 to 25 percent of the surface horizon is gravel.

Creosotebush and white bur-sage make up most of the plant cover. Fourwing saltbush, quailbush, and rubber rabbitbrush grow in included areas where the alluvial fans merge with the wet flood plain.

Most of this soil is used to provide limited grazing for livestock and habitat for upland wildlife. A small area that lies below an irrigation canal is used to produce alfalfa in rotation with small grain. If water is available, this soil is fairly suitable for irrigation. In areas of natural vegetation managed for cattle, the most important plants are shadscale and galleta. (Capability unit IIIs-L, irrigated; VIIs-L, dryland)

Maynard Lake loamy sand, 4 to 12 percent slopes (MlC).—This soil occupies many small alluvial fans and flood plains, and most of it lies between Alamo and Ash Springs. The average slope is about 7 percent.

Included with this soil are areas in which the surface is gravelly or is covered with scattered cobblestones. Also included are a few small areas having slopes of less than 4 percent. These inclusions make up about 10 percent of the total acreage.

Creosotebush, white bur-sage, white burrobrush, and shadscale are dominant in the plant cover. Also common are quailbush, fourwing saltbush, and rubber rabbitbrush in included areas at the lower ends of alluvial fans and blackbrush, Anderson wolfberry, spiny hopsage, and desert pearl at the higher elevations.

This soil is used to furnish limited grazing for livestock and, at the lower end of alluvial fans, habitat for upland wildlife. It is not suitable for cultivation or for irrigation, because it occurs in areas that are too small and too strongly sloping. Shadscale and galleta are the most important plants in grazing areas managed for cattle. (Capability unit VIIs-L, dryland)

McCutchen Series

The McCutchen series consists of medium-textured and moderately coarse textured soils that developed in alluvium derived mainly from ignimbrite. These soils are affected by excess salts and alkali. They occupy nearly level margins of alluvial fans near and just above the Playa in Penoyer Valley.

While the McCutchen soils were developing, drainage likely was poor because the Playa contained water, which impregnated the lower horizons of these soils with a considerable amount of lime. As the Playa lake evaporated, the water table was lowered to its present level.

Representative profile of a McCutchen soil, located about one-fourth mile north of the south quarter corner of section 23, T. 2 S., R. 55 E.:

A11—0 to 1 inch, gray (10YR 6/1) loam, grayish brown (10YR 5/2) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; devoid of plant roots; many very fine interstitial pores; effervescent; pH 8.7; abrupt, smooth boundary.

A12—1 to 3 inches, light-gray (10YR 7/2) loam, brown (10YR 5/3) when moist; moderate, thick, platy structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; few fine and medium roots; many fine and medium vesicular pores; effervescent; pH 8.7; abrupt, smooth boundary.

C1—3 to 10 inches, light brownish-gray (10YR 6/2) fine gravelly loam (15 percent fine gravel), dark brown (10YR 4/3) when moist; weak, thick, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant fine and medium roots; common very fine and fine tubular pores, and many very fine interstitial pores; effervescent; pH 8.7; clear, smooth boundary.

C2—10 to 16 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; strong, medium, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; plentiful very fine and fine roots; many very fine interstitial pores; strongly effervescent; pH 8.7; clear, smooth boundary.

C3ca—16 to 36 inches, light-gray (10YR 7/2) sandy loam, pale brown (10YR 6/3) when moist; massive; very hard when dry, firm when moist, slightly sticky and slightly plastic when wet; few very fine and fine roots; few very fine tubular pores, and many micro and very fine interstitial pores; soil material crumbles in dilute hydrochloric acid; violently effervescent; pH 8.7; clear, wavy boundary.

IIC4ca—36 to 60 inches +, white (10YR 8/2) loamy sand, light brownish gray (10YR 6/2) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; few very fine roots; many very fine interstitial pores; violently effervescent; pH 8.7.

The surface is puddled and has a slightly hard crust 1/8 to 1/4 inch thick. The topmost 2 to 4 inches generally are moderately or strongly vesicular. In texture the A, C1, and C2 horizons are dominantly loam or sandy loam. Gravel occurs in some places, but it does not make up more than 25 percent of any one horizon. The depth to the lime-impregnated C3ca horizon ranges from 12 to 20 inches. This horizon is 12 to 24 inches thick. In some places it is hard when dry, and in some it is very firm when moist. The reaction is strongly alkaline or very strongly alkaline.

The McCutchen soils are well drained. They have slow runoff, slow permeability, and moderate available water capacity. Natural fertility is moderate, and the root zone is very deep. Erosion is a slight hazard.

McCutchen loam (Mn).—This soil occupies a large, smooth, nearly level area northwest of Sand Spring. The average slope is about 1 percent. Shadscale is dominant in the plant cover, and there are smaller amounts of bud sagebrush, little rabbitbrush, graymolly, fourwing saltbush, and greasewood.

Included with this soil are small areas like playas that are less than 1 acre in size. Also included are areas where sandy windblown material has accumulated in hummocks 6 to 8 inches high at the base of scattered shrubs. These inclusions cover less than 2 percent of the total acreage.

This soil is in range that furnishes limited grazing for livestock. It is not suitable for irrigating or cropping, because it is slowly permeable, contains excess salts and alkali, and lies in areas too low in relation to the Playa. On range managed for cattle, the most valuable plants are graymolly, shadscale, and bud sagebrush. (Capability unit VIIs-6, dryland)

Monte Cristo Series

The Monte Cristo series consists of moderately fine textured soils that contain a duripan strongly cemented with silica. These soils developed in alluvium derived from tuff, limestone, dolomite, quartzite, shale, sandstone, and calcareous siltstone. They are on smooth, nearly level alluvial fans or terracelike remnants in Penoyer Valley.

Representative profile of a Monte Cristo soil, located about 1,750 feet north and 500 feet west of the east quarter corner of section 7, T. 2 S., R. 56 E.:

A1—0 to 2 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) when moist; moderate, thick, platy structure; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; few fine roots; many very fine and fine vesicular pores; violently effervescent; pH 8.6; abrupt, smooth boundary.

B&A—2 to 4 inches, light-gray (10YR 7/2) gravelly sandy clay loam, brown (10YR 5/3) when moist; weak, medium and thin, platy structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; few very fine and fine roots; many very fine and fine vesicular pores in upper part, and common very fine and many fine tubular pores in the lower part; common thin clay films on ped faces, and many thin clay films in pores; a few, faint, gray to white speckles on bleached sand and silt grains; violently effervescent; pH 8.8; clear, smooth boundary.

B21t—4 to 8 inches, pale-brown (10YR 6/3) clay loam, yellowish brown (10YR 5/4) when moist; weak, coarse, prismatic structure that breaks readily to weak, thick, platy structure; hard when dry, friable when moist, sticky and plastic when wet; abundant very fine and fine roots; many very fine interstitial pores, and few very fine and fine tubular pores; many thin clay films on ped faces and in pores; strongly effervescent; pH 8.8; clear, smooth boundary.

B22t—8 to 12 inches, light yellowish-brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) when moist; a few, coarse, white mottles of lime; weak, thick, platy structure; hard when dry, friable when moist, sticky and plastic when wet; abundant very fine and fine roots; common fine tubular pores and many very fine and fine interstitial pores; many thin clay films on ped faces and in pores; strongly effervescent in most places, but violently effervescent where lime occurs; pH 9.0; clear, smooth boundary.

B3tca—12 to 15 inches, light-gray (10YR 7/2) heavy loam, light yellowish brown (10YR 6/4) when moist; common, medium, distinct mottles of white lime; weak, medium, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant very fine and fine roots; few very fine and fine tubular pores; few thin clay films on some ped faces and as bridges between sand grains; violently effervescent; pH 8.8; clear, smooth boundary.

C1sicam—15 to 18 inches, light-gray (10YR 7/2), strongly cemented duripan, light yellowish brown (10YR 6/4) when moist; common to many, fine, medium, and coarse, distinct mottles of white lime; strong, thick, platy structure; few very fine and fine roots; few very fine tubular pores; violently effervescent; pH 8.7; clear, smooth boundary.

C2sicam—18 to 30 inches, light-gray (10YR 7/2) strongly cemented duripan, pale brown (10YR 6/3) when moist; common, very fine, faint mottles of white lime; massive; few very fine and fine roots; a few medium and many very fine and fine tubular pores; violently effervescent; pH 8.7; abrupt, wavy boundary.

IIC3—30 to 53 inches, pale-brown (10YR 6/3), stratified gravelly loamy sand and gravelly sand (20 to 40 percent gravel, mostly fine), dark brown (10YR 4/3) when moist; many fine filaments of white lime; massive; hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine and very fine roots; common fine tubular pores, and many fine and very fine interstitial pores; noneffervescent in matrix; pH 8.6; abrupt, wavy boundary.

IIIC4—53 to 55 inches +, variegated light-gray (10YR 7/2) and very dark gray (10YR 3/1) fine sandy loam (5 percent fine gravel), pale brown (10YR 6/3) and black (10YR 2/1) when moist; many, fine, faint, olive (5Y 5/3) and yellowish-brown (10YR 5/6) iron mottles; weak, thick, platy structure; very hard when dry, very firm when moist, nonsticky and slightly plastic when wet; no roots; many very fine interstitial pores; strongly effervescent; pH 8.4.

These soils are slightly or moderately affected by salts and alkali, particularly in the B horizon. The vesicular pores in the A1 and B&A horizons restrict the intake of water. In the lower part of the B horizon, structure is either prismatic or platy. The duripan (C1sicam and C2sicam horizons) ranges from 15 to 24 inches in depth from the surface and from 8 to 16 inches in thickness. In some places there are a few, very thin (less than one-fourth inch thick), discontinuous, indurated lenses in the duripan. Below a depth of 40 inches, the IIC3 and IIIC4 horizons may be marked by light reddish or olive iron mottles, which formed in the past when the water table was high. The reaction ranges from moderately alkaline to very strongly alkaline throughout the profile. Generally, the reaction is lowest in the C horizon and is highest in the B horizon.

Drainage is now good in the Monte Cristo soils, but it likely was poor while the soils were developing, as evidenced by mottles in the C horizon. Runoff and permeability are very slow. Natural fertility is low, and the available water capacity is very low. The hazard of erosion is slight.

Monte Cristo fine sandy loam (Mr).—This soil occupies a nearly level alluvial fan, or terracelike remnant, west of Shadow Well. Most of the acreage is in a single large area, and the rest is in smaller areas. Slopes range from 0 to 2 percent, and the average slope is about 1 percent, but the surface is broken by numerous meandering flood channels. The vegetation consists of graymolly, shadscale, and some fourwing saltbush and bud sagebrush.

Included with this soil are areas that resemble playas and are 10 to more than 100 feet in diameter; sandy ridges and hummocks 12 to 18 inches high that were deposited by wind; and areas of an unnamed soil in which the profile is somewhat similar to that of a Monte Cristo soil but a duripan is lacking. These inclusions make up about 15 percent of the total acreage.

This soil is in range that provides limited grazing for livestock. It is not suitable for cropping and irrigating, because it has a shallow root zone, is very slowly permeable, and contains excess salts and alkali. On range managed for cattle, the most important plants are graymolly, shadscale, and bud sagebrush. (Capability unit VIIs-8, dryland)

Nevoyer Series

The Nevoyer series consists of gravelly, medium-textured soils that formed in material weathered in place from ignimbrite. These moderately sloping to strongly sloping soils lie on the sides of foothills and on ridgetops in the Penoyer Area.

Representative profile of a Nevoyer soil, located about 500 feet east and 100 feet north of the south quarter corner of section 11, T. 2 S., R. 54 E.:

A1—0 to 2 inches, light-gray (10YR 7/2) gravelly loam (30 percent gravel), dark grayish brown (10YR 4/2) when moist; massive; soft when dry, friable when moist, nonsticky and slightly plastic when wet; plentiful very fine and few fine roots; many very fine and fine vesicular pores; pH 8.4; clear, smooth boundary.

B2—2 to 9 inches, light brownish-gray (10YR 6/2) gravelly loam (20 to 25 percent gravel), dark grayish brown (10YR 4/2) when moist; weak, medium and fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant fine and very fine roots; many very fine and fine tubular pores; pH 8.4; clear, wavy boundary.

Cca—9 to 17 inches, similar to B2 horizon in color and texture; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant very fine and fine roots; many very fine and fine tubular pores; noneffervescent except in the lower part where lime occurs as a thin film on pebbles; pH 8.4; abrupt, wavy boundary.

R—17 inches +, hard tuff bedrock; an extremely hard silica-lime crust about 1/16 to 1/8 inch thick is cemented to the top of the rock.

Covering the surface are pebbles 1 to 3 inches across that form a weakly or moderately developed gravel pavement. Here, the content of gravel ranges from 30 to 50 percent. The A1 horizon has moderate vesicular porosity. The texture throughout the profile is dominantly gravelly loam, but in places there are strata of gravelly sandy loam or gravelly fine sandy loam. From 20 to 40 percent of the soil mass consists of coarse fragments, which may be pebbles, cobblestones, or stones. In some places the Cca horizon is weakly cemented with lime and is hard when dry. The crust of silica and lime that forms a cap on the tuff bedrock is 1/16 to 1/2 inch thick. The reaction ranges from moderately alkaline in the uppermost 3 to 9 inches of these soils to strongly alkaline just above bedrock.

Drainage is good in the Nevoyer soils. Runoff is medium to rapid, depending on slope, and permeability is moderate. The soils have low natural fertility, very low available water capacity, and a shallow or very shallow root zone. They are moderately susceptible to erosion.

Nevoyer gravelly loam, 4 to 12 percent slopes (NeD).—This moderately sloping to strongly sloping soil lies in low foothills along the boundary of the Penoyer Area west of Sand Spring. The plant cover is made up of galleta, Indian ricegrass, shadscale, littleleaf horsebrush, Mormon-tea, and some black sagebrush.

Included with this soil are small outcrops of rock in areas that are scattered but occur mainly along the ridgetops. Also included are some stony and cobbly areas. These inclusions occupy about 15 percent of the total acreage.

This soil produces a small amount of forage for livestock. It is not suitable for cultivation or for irrigation, because it is too strongly sloping, is too shallow to bedrock, and has very low available water capacity. On range managed for cattle, the most important plants are Indian ricegrass, desert needlegrass, and galleta. (Capability unit VIIs-8, dryland)

Nyala Series

Soils of the Nyala series occur on gently sloping alluvial fans in Penoyer Valley. These soils formed in alluvium derived from tuff, limestone, dolomite, quartzite, shale, sandstone, and siltstone.

Representative profile of a Nyala soil, located about 550 feet north and 100 feet east of the center of section 21, T. 2 S., R. 56 E.:

A11—0 to 3 inches, light-gray (10YR 7/2) sandy loam, dark brown (10YR 4/3) when moist; moderate, thick, platy structure; slightly hard when dry, friable when

moist, nonsticky and nonplastic when wet; few very fine and fine roots; many very fine and fine vesicular pores; violently effervescent; pH 8.6; abrupt, smooth boundary.

A12—3 to 12 inches, pale-brown (10YR 6/3) sandy loam (10 percent gravel), dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine roots, and abundant very fine roots; many fine and very fine tubular pores; strongly effervescent; pH 8.4; clear, smooth boundary.

B2t—12 to 18 inches, pale-brown (10YR 6/3) sandy clay loam with few to common, fine and medium segregations of white lime, dark yellowish brown (10YR 4/4) when moist; massive (structureless) or weak, fine, subangular blocky structure; hard when dry, very friable when moist, sticky and plastic when wet; abundant very fine and fine roots; many very fine and fine tubular pores; many thin clay films in pores and on sand grains, and few thin clay bridges between sand grains; violently effervescent; pH 9.2; abrupt, smooth boundary.

B3tca—18 to 22 inches, pale-brown (10YR 6/3) sandy clay loam with common, coarse segregations of white lime and common, fine, very hard nodules of lime that range up to one-quarter inch in diameter, dark yellowish brown (10YR 4/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; abundant very fine and fine roots; many very fine and fine tubular pores; thin continuous clay films in pores and on sand grains; violently effervescent; pH 9.4; clear, wavy boundary.

C1sicam—22 to 32 inches, white (10YR 8/2) sandy loam, light gray (10YR 7/2) when moist; weak, thick, platy structure; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; few very fine and fine roots; few fine tubular pores, and many micro interstitial pores; weakly silica cemented; violently effervescent; pH 9.6; clear, wavy boundary.

C2sica—32 to 42 inches, light-gray (10YR 7/2) sandy loam, brown (10YR 5/3) when moist; weak, thick, platy structure; hard when dry, friable when moist, nonsticky and nonplastic when wet; few very fine and fine roots; few fine tubular pores, and many micro interstitial pores; few, hard, firm durinodes; violently effervescent; many very fine filaments of white lime; pH 9.6; clear, wavy boundary.

IIC3—42 to 55 inches, light-gray (10YR 7/2) loamy sand, brown (10YR 5/3) when moist; few thin lenses of sandy loam that are hard when dry and firm when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; few very fine and fine roots; few very fine tubular pores, and many micro interstitial pores; violently effervescent; pH 9.6; abrupt, smooth boundary.

IIC4—55 to 72 inches +, pale-brown (10YR 6/3) gravelly light loamy sand (20 percent fine gravel), brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine roots; many very fine interstitial pores; violently effervescent; pH 9.6.

The thickness of the A horizon ranges from 8 to 13 inches. The A11 horizon has platy structure or is structureless (massive), and it has strongly developed vesicular porosity. In the B horizon the texture is dominantly sandy clay loam but, in some places, is clay loam. The gravel content throughout the profile generally is less than 20 percent, though it may be as much as 70 percent in the lower C horizon. The reaction ranges from moderately alkaline to very strongly alkaline and increases with depth.

These well-drained soils have slow runoff, moderately slow permeability, and moderate available water capacity. They are high in natural fertility and have a very deep root zone. Erosion is a slight hazard.

The Nyala soils occur with the Fang soils, and they were mapped only in an association with those soils. A description of the Fang-Nyala association, 2 to 4 percent slopes, is given under the heading "Fang Series."

Pahranagat Series

Soils of the Pahranagat series are silty, but they are erratically stratified with layers of medium-textured to fine-textured material, and they contain an occasional thin layer of muck or mucklike material. These soils developed in stream-deposited sediments that were derived from many kinds of igneous and sedimentary rocks. They are on smooth, gently convex or gently concave, nearly level flood plains throughout the Pahranagat Valley. During their development the soils were covered by wet meadow.

Representative profile of a Pahranagat soil, located in a cultivated field about 1,000 feet south and 1,150 feet east of the north quarter corner of section 8, T. 7 S., R. 61 E.:

Ap—0 to 10 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant very fine and fine roots; many very fine tubular pores, and many micro interstitial pores; strong effervescence; pH 8.3; abrupt, smooth boundary.

A12—10 to 15 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant very fine and fine roots; many very fine and fine tubular pores; common, medium, faint, dark-gray (10YR 4/1) and black (10YR 2/1) worm casts; few, very fine, faint, yellowish-brown (10YR 5/4) iron mottles; strong effervescence; pH 8.3; abrupt, wavy boundary.

IIC1—15 to 21 inches, gray (10YR 6/1) silty clay, high in organic-matter content, very dark gray (10YR 3/1) when moist; weak, medium and fine, granular structure; very hard when dry, friable when moist, very sticky and very plastic when wet; abundant very fine and fine roots; many very fine and common fine tubular pores; moderate quantity of fine mica; slight effervescence; pH 8.3; abrupt, wavy boundary.

IIIA'1g—21 to 23 inches, gray (10YR 5/1) silt loam, high in organic-matter content, black (10YR 2/1) when moist; structureless (massive); very hard when dry, friable when moist, slightly sticky and slightly plastic when wet; plentiful very fine and fine roots; common very fine and fine tubular pores; few fine distinct flecks of white (10YR 8/1) lime or gypsum; few to common, fine, distinct mottles of reddish-brown (5YR 5/4) iron; slight effervescence; pH 8.3; abrupt, wavy boundary.

IIIC'2—23 to 26 inches, light-gray (10YR 6/1) loam or silt loam, dark gray (10YR 4/1) when moist; massive; hard when dry, friable when moist; slightly sticky and slightly plastic when wet; plentiful very fine and fine roots; common very fine and fine tubular pores; strong effervescence; pH 8.3; abrupt, wavy boundary.

IIIC'3—26 to 34 inches, strongly mottled grayish-brown (10YR 5/2) and light-gray (2.5Y 7/2) silt loam, very dark grayish brown (10YR 3/2) and dark grayish brown (2.5Y 4/2) when moist; massive; hard when dry, friable when moist, nonsticky and slightly plastic when wet; plentiful very fine and fine roots; common very fine and few fine tubular pores; slight effervescence; pH 8.3; abrupt, wavy boundary.

IIIC'4—34 to 41 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; common, very fine, faint very dark grayish-brown (2.5Y 3/2) iron mottles; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant very fine and fine roots; common very fine and fine tubular pores; strong effervescence; pH 8.3; abrupt, smooth boundary.

IVA'1—41 to 45 inches, gray (10YR 5/1) silty clay, black (10YR 2/1) when moist; massive; very hard when dry, firm when moist, very sticky and very plastic when wet; few very fine and fine roots; few very fine tubular pores; strong effervescence; pH 8.3; abrupt, smooth boundary.

VC'5—45 to 48 inches +, grayish-brown (2.5Y 5/2) silt loam, very dark grayish brown (2.5Y 3/2) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; few very fine tubular pores; few to common, very fine, prominent, light yellowish-brown (2.5Y 6/4) iron mottles; few, fine, distinct flecks of white (10YR 8/2) lime; strong effervescence; pH 8.3.

The thickness of the A horizon ranges from 10 to 20 inches. The content of organic matter in the A horizon ranges from 1.5 to 20 percent, but if the material in this horizon were mixed, the organic-matter content would be 3 to 8 percent. If the soil material throughout the profile were mixed, the dominant texture would be silt loam or silty clay loam. In many places the profile is stratified with layers that range from very fine sandy loam to silty clay. In places where more than one A horizon is present in the profile, the buried A horizon ranges from 1 to 8 inches in thickness. Iron mottles or gleyed, yellowish strata are common in the C horizon. The mica content is high in some strata, but mica is lacking in others. The reaction ranges from moderately alkaline to very strongly alkaline, depending on the content of sodium. Because of differences in drainage and the extent of salt removal by leaching, the salinity ranges from none to strong.

The Pahranagat soils are poorly drained or somewhat poorly drained. The depth to the water table ranges from a few inches in seeped areas to 4 or 5 feet in somewhat poorly drained areas. The water table fluctuates throughout the year, but it is highest in winter. Surface runoff is very slow, permeability is moderately slow, and the available water capacity is high. The soils are high in natural fertility and have a very deep root zone. They are only slightly susceptible to erosion.

These soils are irrigated. They are used for locally suited crops or for native meadow. Molybdenum toxicity in livestock is a hazard in areas where introduced species of clover are grazed.

Pahranagat silt loam (Pa).—This soil occurs in several areas along the flood plain above Pahranagat Lakes. The soil is nearly level; it has an average slope of about 0.5 percent. Drainage is poor, and the water table fluctuates between the depths of 18 and 36 inches throughout the year. The A horizon is free of excess salts.

Included with this soil are areas in which the A horizon is silty clay loam. Also included are areas of silt loam that are slightly affected by salts. These inclusions make up about 20 percent of the total acreage.

This soil is irrigated and is used for the production of grass in unimproved meadow. It also provides habitat for wildlife. It is suited to crops that are water tolerant, especially those that are cut for hay or are pastured. Leveling is needed for improving irrigation in some areas. (Capability unit IIIw-9P, irrigated)

Pahranagat silt loam, drained (Pb).—This soil lies in several large areas between Alamo and Lower Pahranagat Lake. Deep drains provide the drainage needed for keeping the water table at a depth of 4 to 5 feet most of the year. The soil formerly contained soluble salts in amounts injurious to plants, but the salt content has been reduced through irrigation and good management.

Included with this soil, along the edge of cultivated fields, are a few small areas that are slightly saline.

This soil is used for irrigated crops and as habitat for wildlife. Except for an occasional heavy irrigation to maintain a favorable salt balance, careful use of irrigation water is necessary on this soil. (Capability unit IIw-9, irrigated)

Pahranagat silt loam, drained, slightly saline (Pc).—This soil is on the nearly level flood plain between Alamo and Lower Pahranagat Lake. Here, it is drained by deep ditches, but drainage remains somewhat poor, and the fluctuating water table is at a depth of 48 to 60 inches most of the year. The soil is slightly affected by salts in the upper 10 to 12 inches.

About 5 percent of the total acreage consists of several included areas in which the Ap horizon is free of excess salts.

This soil is irrigated and is used for alfalfa, small grain, pasture, and native meadow. In addition, it provides habitat for wildlife. Areas now in meadow are suitable for cultivation, but leveling is needed in some places. Also, a large amount of irrigation water is required periodically to help reduce salinity in the Ap horizon. (Capability unit IIw-69, irrigated)

Pahranagat silt loam, slightly saline (Pd).—This soil occurs on the nearly level flood plain in the vicinity of Lower Pahranagat Lake. The surface horizon, to a depth of 10 to 12 inches, is slightly affected by salts and is strongly alkaline. The water table fluctuates between the depths of 18 and 30 inches throughout the year.

Included with this soil, between Hiko Springs and Hiko Lake, is a small area in which the surface horizon is 4 to 6 inches of silty clay loam that is strongly saline. Also included, north of Lower Pahranagat Lake, is a small area where the surface horizon is fine sandy loam 10 to 14 inches thick and is slightly saline. These inclusions make up about 30 percent of the total acreage. They are used and managed in much the same way as Pahranagat silt loam, slightly saline.

Some areas of this soil are in meadow that is used for hay or is grazed. Other areas are used for irrigated pasture. In addition, the soil furnishes habitat for wildlife. It is suited to crops that are tolerant of excess water and of salts and alkali, but leveling is needed for efficient use of irrigation water. (Capability unit IIIw-69P, irrigated)

Pahranagat-Ash Springs complex (Pe).—This complex consists of soils that are in such an intricate pattern that it was not practical to map them separately. It occupies nearly level areas on flood plains in Pahranagat Valley. The relief is undulating, for there are many shallow swales and slightly rolling ridges.

About 45 percent of the complex is Pahranagat silt loam, slightly saline; 45 percent is Ash Springs silt loam; and 10 percent is included small areas of other soils.

Both of the major soils are poorly drained, but the Pahranagat soil occupies low areas and is dark colored, whereas the Ash Springs soil is in slightly higher areas and is light colored. The Ash Springs soil is further described on page 13.

The included soils are mainly Pahranagat silt loam, seeped, which lies in potholes, and strongly saline Ash Springs silt loam, which occurs in high positions that cannot be irrigated.

All the acreage is in unimproved meadow that is grazed or cut for hay and provides habitat for wildlife. If the soils are leveled, they can be used for irrigated crops. (Capability unit IIIw-69P, irrigated)

Pahranagat-Ash Springs complex, seeped (Pg).—This complex lies in a nearly level, slightly concave, troughlike part of the Pahranagat Valley flood plain, where the water table is at or near the surface most of the year. About 60 percent of the complex is Pahranagat silt loam, seeped, slightly saline; 35 percent is Ash Springs silt loam, seeped, slightly saline; and 5 percent is included small areas of a Pahranagat soil having a 2- to 4-inch surface layer of peat.

Pahranagat silt loam is a dark-colored soil that lies in shallow depressions, where the water table is at or very near the surface. This soil is slightly affected by salts in the upper 4 to 6 inches. In some places below a depth of 18 inches, there are several layers of muck 2 to 6 inches thick.

Ash Springs silt loam, a light-colored soil that is slightly saline, occurs in slightly higher terracelike areas. Here, the water table is within 10 to 14 inches of the surface. In some places the soil contains strata of muck, 1 to 4 inches thick, below a depth of 36 inches. A representative profile of an Ash Springs soil can be found on page 13.

The soils of this complex are in meadow that is grazed by livestock and is used as habitat by migratory wildlife. They are too wet for cultivation. (Capability unit Vw-2, irrigated)

Pahranagat-Ash Springs variant complex (Ph).—This complex is on the nearly level flood plain of the Pahranagat Valley, in the northern half of the Crystal Spring watershed. The surface is slightly undulating, and the general pattern is one of shallow swales and slightly higher terracelike areas.

About 55 percent of the complex is Pahranagat silt loam, slightly saline; 40 percent is Ash Springs silty clay loam, heavy subsoil variant, slightly saline; and 5 percent is inclusions, mainly small areas of strongly saline Ash Springs soils that cannot be irrigated from existing ditches.

Pahranagat silt loam is dark colored and occurs in low, concave positions. Ash Springs silty clay loam, heavy subsoil variant, is light colored, occupies slightly higher positions, and has a high content of clay below the A horizon. Both soils are poorly drained. The Ash Springs soil is further described on page 13.

The soils of this complex are in meadow that provides grazing for livestock and habitat for wildlife. Both soils are suited to crops that are tolerant of excess water and salts, but they need to be leveled for efficient use of irrigation water. (Pahranagat soil: capability unit IIIw-69P, irrigated; Ash Springs soil: capability unit IVw-369P, irrigated)

Pahranagat-Ash Springs variant complex, drained (Pk).—This complex is on the nearly level flood plain of Pahranagat Valley, in the northern part of the Crystal Spring watershed. It consists of many shallow swales and slightly higher ridgelike areas. Here, the irrigation ditches are lined to reduce seepage, and consequently the water table is lowered to a depth of 3 to 5 feet.

About 55 percent of the complex is Pahranagat silt loam, drained, slightly saline; 40 percent is Ash Springs silt loam, heavy subsoil variant, somewhat poorly drained, slightly saline; and 5 percent is small included areas of other soils.

Pahranagat silt loam is a dark-colored soil that occupies low-lying areas. Ash Springs silt loam, heavy subsoil variant, is light colored and occurs in slightly raised areas. The Ash Springs soil is very strongly alkaline in the A horizon, is clayey below the A horizon, and generally has a fluctuating water table at a depth of 3 to 5 feet. A representative profile of an Ash Springs soil, heavy subsoil variant, is described on page 14.

The inclusions are mainly a strongly saline Ash Springs soil, heavy subsoil variant, that occupies high spots and cannot be irrigated, and areas of poorly drained Pahranagat silt loam in potholes.

The soils of this complex are covered with meadow plants that are used for grazing and furnish habitat for wildlife. The soils are suitable for cropping, but they can be irrigated more efficiently if they are leveled. (Pahranagat soil: capability unit IIw-69, irrigated; Ash Springs soil: capability unit IIIw-69P, irrigated)

Pahroc Series

In the Pahroc series are very gravelly, medium-textured soils that contain a hardpan cemented with silica and lime. These soils developed in alluvium derived from ignimbrite, dolomite, limestone, quartzite, sandstone, and shale. They are on dissected, gently sloping to moderately sloping old alluvial fans in Pahranagat Valley.

Representative profile of a Pahroc soil, located northwest of Hiko near the road to Coal Valley, approximately 0.4 mile west of State Highway 38 and about 30 feet south of the Coal Valley road, in an unsurveyed township:

A1—0 to 2½ inches, light-gray (10YR 7/2) gravelly loam, grayish brown (10YR 5/2) when moist; weak, thick, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; no roots; many fine and medium vesicular pores; contains 30 percent gravel; violently effervescent; pH 8.6; abrupt, smooth boundary.

C1—2½ to 6 inches, very pale brown (10YR 7/3) gravelly loam (30 to 35 percent gravel), brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine roots; many very fine to fine pores; violently effervescent; pebbles have stalactitelike coatings of lime on under side; pH 8.6; clear, wavy boundary.

C2ca—6 to 12 inches, very pale brown (10YR 8/3) very gravelly loam, brown (10YR 5/3) when moist; massive; hard when dry, friable when moist, slightly sticky and nonplastic when wet; few fine and very fine roots; many very fine and fine interstitial pores; contains 50 percent gravel; violently effervescent; pH 8.5; abrupt, slightly wavy boundary.

C4sicam—12 to 32 inches, white (10YR 8/1), indurated, very gravelly silica-lime cemented hardpan, light gray (10YR 7/2) when moist; massive; no roots; very few, very fine pores; the upper part of the horizon has a laminar surface that is very dense and contains no visible pores; no roots; violently effervescent; pH 8.6; gradual, wavy boundary.

IIC5ca—32 to 60 inches +, white (10YR 8/2), marly and weakly lime-cemented very gravelly coarse sandy loam, pale brown (10YR 6/3) when moist; massive; slightly hard or hard when dry, firm and loose when moist, nonsticky and nonplastic when wet; no roots; many very fine and fine and few medium interstitial pores; contains several thin (less than 2 inches thick) continuous laminar strata that are extremely hard and extremely firm; violently effervescent; lime coatings on practically all pebbles; pH 8.4.

Coarse fragments, consisting mainly of pebbles but partly of stones and cobblestones, cover at least 65 percent of the soil surface and form a gravelly erosion pavement. The fragments are chiefly dolomite and limestone. They have a thin desert varnish on exposed parts, and there are pendants or stalactites of calcium carbonate on the lower side. In the A1 horizon, vesicular porosity is strongly developed. Above the hardpan the texture is dominantly gravelly loam or very gravelly loam and the gravel content ranges from 30 to 60 percent. Cobblestones are present but are not common. The hardpan begins at a depth ranging from 10 to 20 inches and has a thickness ranging from 18 to 36 inches. Below the hardpan the content of gravel is at least 70 percent. The reaction ranges from moderately alkaline to very strongly alkaline.

These soils are well drained and have medium runoff. They are very slowly permeable, have very low available water capacity, are low in natural fertility, and have a shallow root zone. The hazard of erosion is moderate.

Pahroc gravelly loam, 2 to 8 percent slopes (PlC).—This extensive soil lies on gently sloping and moderately sloping alluvial fans northwest of Crystal Spring and Hiko Spring in Pahranagat Valley. The vegetation is mainly blackbrush, but there are small amounts of Mormon-tea, dahlia, galleta, and bush muhly.

Included with this soil are very gravelly areas that have a gravel content of 50 to 60 percent in the A horizon. Also included are very gravelly Carrizo soils in narrow drainageways, and very steep escarpments adjacent to the drainageways. These inclusions cover about 20 percent of the total acreage.

This soil is in range, but its use for grazing is limited. It is not suitable for cultivation or for irrigation, because the root zone is shallow and the available water capacity is very low. (Capability unit VIIs–8, dryland)

Papoose Series

The Papoose series consists of moderately coarse textured and moderately fine textured soils that developed in alluvium derived mainly from tuff, basalt, and andesite and, to a small extent, from limestone and quartzite. These soils are on nearly level and gently sloping alluvial fans in Penoyer Valley.

Representative profile of a Papoose soil, located about 1,150 feet west and 630 feet north of the southeast corner of section 32, T. 4 S., R. 55 E.:

A1—0 to 3 inches, very pale brown (10YR 7/3) sandy loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few fine and medium roots; many fine and medium vesicular pores; slight effervescence; pH 8.5; abrupt, smooth boundary.

B1—3 to 7 inches, light brownish-gray (10YR 6.5/2) light sandy clay loam (very pale brown (10YR 7/3) crushed), brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine and medium roots; many very fine and fine interstitial pores; slight effervescence; pH 8.5; clear, wavy boundary.

B2t—7 to 16 inches, pale-brown (10YR 6/3) light sandy clay loam, yellowish brown (10YR 5/4) when moist; moderate, medium and coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; plentiful very fine and fine roots; many very fine and fine tubular pores; many thin clay films in pores and on ped faces; strong effervescence; pH 8.5; clear, wavy boundary.

C1—16 to 26 inches, light-brown (7.5YR 6.5/4) fine sandy loam (10 percent fine gravel), brown (7.5YR 5/4) when moist; weak, medium and fine, granular structure; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; plentiful very fine and fine roots; common very fine and fine tubular pores; strong effervescence; common, fine, prominent segregations of white (10YR 8/2) lime; pH 8.5; clear, smooth boundary.

IIC2—26 to 33 inches, light-brown (7.5YR 6/4) gravelly loamy sand (25 percent fine gravel), brown (7.5YR 5/4) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine roots; very porous; slight effervescence; pH 8.5; abrupt, smooth boundary.

IIIC3—33 to 60 inches +, light-brown (7.5YR 6/4) very gravelly coarse sand (60 percent fine gravel), brown (7.5YR 5/4) when moist; single grain; loose when dry or moist; very fine roots, plentiful in upper part, few in lower part; very porous; generally slight effervescence but no effervescence in places; some pebbles have a thin coating of lime on lower sides; pH 8.2.

The A horizon has platy structure or is structureless (massive). It has vesicular porosity throughout, except where it is covered with sandy material deposited by wind under shrubs. Here, the A horizon contains vesicular pores only in the lower part. In the B and C1 horizons, the texture is light sandy clay loam or heavy fine sandy loam and the structure generally is subangular blocky or prismatic. In places, however, the C1 horizon is structureless (massive). The depth to the gravelly, coarse-textured IIC2 horizon ranges from 22 to 28 inches. The depth to the IIIC3 horizon is 30 to more than 60 inches. Unconformable, moderately fine textured material also occurs in places below 36 inches. The reaction ranges from mildly alkaline to very strongly alkaline. Some areas are slightly affected by excess salts and alkali.

The Papoose soils are well drained. Runoff is slow, permeability is moderate or moderately slow, and the available water capacity is low or moderate. Erosion is a slight or moderate hazard.

Most areas of these soils are used to provide limited grazing for livestock. A small area is used for cultivated crops that are irrigated by pumping ground water. A large acreage of Papoose soils is suitable for cultivation if water can be made available for irrigation.

Papoose loamy fine sand, 0 to 2 percent slopes (PmA).—This nearly level soil occurs in the windy trough south

of State Route 25 in Penoyer Valley. Here, the surface is covered with 4 to 6 inches of loamy fine sand laid down by wind. Underlying the loamy fine sand is a layer of sandy loam about 3 inches thick. In other respects the profile is similar to the one described for the series. The surface generally is smooth, but in some places windblown material lies in drifts and hummocks 6 to 8 inches high. Permeability is moderate, and the available water capacity is low. Soil blowing is a moderate hazard. The vegetation consists chiefly of winterfat, bud sagebrush, and fourwing saltbush, and there is a small amount of Indian ricegrass and galleta.

Small areas of Fang loamy fine sand are included, but they make up less than 10 percent of the total acreage.

This soil is used for range and as habitat for upland wildlife. It is suitable for developing as irrigated cropland. On range managed for cattle, the most important plants are winterfat, fourwing saltbush, and Indian ricegrass. (Capability unit IIIs-L, irrigated; VIIs-4, dryland)

Papoose sandy loam, 0 to 2 percent slopes (PnA).—This nearly level soil occupies a few large alluvial fans south of State Route 25 in Penoyer Valley. It is moderately permeable, has low available water capacity, and is slightly susceptible to erosion. The plant cover consists mainly of winterfat, bud sagebrush, and fourwing saltbush, and there is a small amount of Indian ricegrass and galleta.

Included with this soil, between the Penoyer Valley playa and State Route 25, is a small area in which the soil is loam to an average depth of 10 inches. Also included are areas having a surface horizon of loamy fine sand laid down by wind, and many areas of playalike material 5 to 50 square feet in size. These inclusions make up about 15 percent of the total acreage.

Most of this soil is used for limited livestock grazing and as habitat for upland wildlife. A small area is used for irrigated crops. All of the soil can be leveled and cropped if water is made available, but frequent, light irrigations are needed because the available water capacity is low. Winterfat, fourwing saltbush, and Indian ricegrass are the most important plants on range managed for cattle. (Capability unit IIIs-4, irrigated; VIIs-4, dryland)

Papoose sandy loam, 0 to 2 percent slopes, eroded (PnA2).—This soil occurs in the vicinity of Sundown Well and along the southern edge of the Playa in Penoyer Valley. It occupies nearly level alluvial fans that are dissected by many shallow drainage channels. It has hummocky or undulating relief and is subject to blowing and deposition by wind. In most places the profile has been thinned by erosion, but otherwise it is similar to the one described as representative of the series. The surface horizon lacks the vesicular crust that is normal for Papoose soils, and, because of wind action, it is loose when dry or moist. In the B and upper C horizons, the texture is heavy sandy loam. Permeability is moderate, the erosion hazard is moderate, and the available water capacity is low. Galleta, bud sagebrush, and shadscale make up most of the plant cover, but winterfat also occurs.

About 10 percent of the total acreage consists of small included areas in which the surface horizon is sandy.

This soil is used for range and as habitat for upland wildlife. It is suitable for cropping under irrigation. To control erosion in fields newly prepared for irrigation, diversions may be needed to intercept runoff from higher lying soils. On range managed for cattle, the most important plants are galleta, bud sagebrush, and winterfat. (Capability unit IIIs-4, irrigated; VIIs-4, dryland)

Papoose sandy loam, 2 to 4 percent slopes (PnB).—This soil lies on the lower part of a large, gently sloping alluvial fan near the southeastern rim of Penoyer Valley. The fan is relatively smooth but is cut by a few drainage channels 3 to 5 feet deep. On an average, the general slope is about 3 percent. Permeability is moderate, the available water capacity is low, and the hazard of erosion is moderate. Winterfat and fourwing saltbush make up most of the plant cover, and there is a small amount of Indian ricegrass and bud sagebrush.

About 10 percent of the total acreage consists of small included areas in which the surface is gravelly.

This soil is used for range and as habitat for upland wildlife. On range managed for cattle, the most valuable plants are winterfat, fourwing saltbush, and Indian ricegrass. The soil is suitable for developing as irrigated cropland. (Capability unit IIIe-4, irrigated; VIIs-4, dryland)

Papoose sandy loam, slightly saline, 0 to 2 percent slopes (PoA).—This soil occurs in two large areas in Penoyer Valley. One area is south of State Route 25, and the other is between that route and the Playa. The average slope is about 1 percent, and the surface generally is smooth, but the lower of the two areas is dissected by many drainage channels 2 to 3 feet deep. In the surface horizon the soil is slightly affected by salts and is very strongly alkaline. Below a depth of 36 inches, it consists of unconformable, moderately fine textured material that was laid down in the bed of an ancient lake. Otherwise the profile is similar to the one described for the series. Permeability is moderately slow, the available water capacity is moderate, and the erosion hazard is slight. Graymolly, shadscale, and some galleta are dominant in the plant cover.

Included with this soil are small areas of Papoose soils that lack the moderately fine textured material below a depth of 36 inches. Also included are areas of these soils that are eroded, and areas that are free of salts in the surface horizon. The inclusions make up about 10 percent of the total acreage.

Range and habitat for upland wildlife are the uses made of this soil. On range managed for cattle, the most important plants are graymolly, shadscale, and galleta. Cultivated crops can be grown under irrigation, and the salt content can easily be reduced by irrigating properly. (Capability unit IIs-4, irrigated; VIIs-4, dryland)

Peat

Peat (Pp) consists of calcareous, fibrous, organic soil material that occupies nearly level basins close to Alko and Lower Pahranagat Lake in the Pahranagat Area. This material extends to a depth of about 60 inches and contains thin lenses of silty mineral material. It is slightly saline in some places and is free of salts in others. The water table is at the surface most of the year. In

265-477—68——4

some areas the surface is covered with very pale brown silt loam, as much as 4 inches thick, that washed from higher soils. The vegetation is a thick stand of tules.

Peat is very poorly drained. It has very slow runoff, is moderately permeable, and has very high available water capacity. Erosion is not a hazard, but oxidation is likely in areas that are drained.

About 15 percent of the total acreage consists of an included area of Peat that has been partially drained. In this area a deep drainage ditch keeps the water table at a depth of 20 to 36 inches. Consequently, the organic material has shrunk in volume and is severely cracked.

Peat is used for limited grazing and as habitat for migratory wildlife. Because it shrinks and cracks if drained, it is not suitable for use as cropland. (Capability unit Vw–2, irrigated)

Penoyer Series

The Penoyer series consists of silty soils that developed in alluvium from many kinds of rocks, including limestone, basalt, tuff, and sandstone, and from older lacustrine sediments. These soils occupy smooth and very gently concave, nearly level areas on flood plains, in basins, and on toe slopes of alluvial fans in both the Pahranagat and the Penoyer Valleys.

Representative profile of a Penoyer soil, located about 700 feet south and 200 feet east of the northwest corner of section 8, T. 4 S., R. 62 E.:

A1—0 to 4 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4.5/3) when moist; moderate or weak, thick, platy structure; hard when dry, friable when moist, very slightly sticky and very slightly plastic when wet; very few fine and medium roots; common very fine and fine vesicular pores; strongly effervescent; pH 8.8; gradual, smooth boundary.

C1—4 to 17 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4.5/3) when moist; massive (structureless); slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine, fine, and medium roots; common fine and medium vesicular pores; strongly effervescent; pH 8.8; gradual, smooth boundary.

C2—17 to 41 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4.5/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine, fine, and medium roots; common fine and medium vesicular pores, and few fine tubular pores; strongly effervescent; pH 8.8; clear, smooth boundary.

C3—41 to 60 inches +, pale-brown (10YR 6/3) silt loam, brown (10YR 4.5/3) when moist; weak, thick, platy structure but nearly massive in places; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine and very fine roots; few fine and very fine tubular pores; strongly effervescent; pH 8.8.

The texture in the profile is dominantly silt loam, but in some places there are strata of very fine sandy loam, loam, fine sandy loam, or silty clay loam. In undisturbed areas a moderately to strongly developed vesicular crust is common and vesicular pores occur throughout most of the profile. The reaction ranges from moderately alkaline to very strongly alkaline. Some areas are slightly or moderately affected by excess salts and alkali, and in these areas the alkalinity is strongest.

These soils are well drained, have very slow runoff, and have high available water capacity. Permeability is slow in undisturbed areas but is moderately slow in cultivated fields. Natural fertility is high, and the root zone is very deep. Soil blowing is a moderate hazard, especially in fields where the surface is left unprotected. Some areas are subject to occasional overflow.

The Penoyer soils generally are in range, but they produce little forage for livestock. They also are used as habitat for upland wildlife. A few small areas are cropped under irrigation. The soils are well suited to irrigated crops, and favorable yields can be expected.

Penoyer loam, moderately saline-alkali (Pr).—This soil occupies a large area on the eastern side of the playa in Penoyer Valley. It lies on the nearly level toe slopes of an alluvial fan, where its surface is somewhat undulating because of converging drainage channels. The upper part of this soil is 8 to 14 inches of loam that is moderately affected by salts and alkali, but in other respects the profile is similar to the one described for the series. This 8- to 14-inch layer is very strongly alkaline. Fourwing saltbush, greasewood, and graymolly make up the plant cover.

Included with this soil are small areas that are slightly or strongly affected by salts and alkali. Also included, along the lower edge of the alluvial fan, are small basins that resemble playas. These inclusions cover about 10 percent of the total acreage.

This soil is in range that provides limited grazing for livestock and habitat for upland wildlife. On range managed for cattle, the most important plants are graymolly and fourwing saltbush. The soil can be reclaimed, leveled, and irrigated if water is made available. After most of the salts and alkali have been removed, all crops suited to the climate can be grown. (Capability unit I–1, irrigated; VIIs–6, dryland)

Penoyer loam, slightly saline-alkali (Ps).—This soil occurs on smooth, nearly level, converging alluvial fans on the eastern side of the Penoyer Valley playa. Slopes are smooth and average about 1 percent. The upper part of the soil, to a depth of 6 to 14 inches, consists of loam that is slightly affected by salts and alkali but is very strongly alkaline. Otherwise, the profile is similar to the one described for the series. The concentration of salts and alkali generally is moderate below a depth of 18 inches, but in some places it is strong at a depth exceeding 48 inches. Fourwing saltbush, greasewood, and graymolly are the principal plants.

Included with this soil are areas in which the surface horizon is silt loam that is slightly saline-alkali. Also included are areas that are free of salts and alkali. These inclusions make up about 10 percent of the total acreage.

This soil is used for range and as habitat for upland wildlife. It is suitable for use as irrigated cropland, but the content of salts and alkali must be reduced before all crops suited to the climate can be grown. On range managed for cattle, the most important plants are graymolly and fourwing saltbush. (Capability unit I–1, irrigated; VIIs–6, dryland)

Penoyer silt loam (Pt).—This soil is on the smooth, nearly level flood plain north of Hiko Spring in Pahranagat Valley. Here, the average slope is about 1 percent. Winterfat forms most of the plant cover and grows in dense stands, but there is some galleta and Indian ricegrass.

About 5 percent of the total acreage consists of small included areas, or pockets, that were covered with 2 to

9 inches of moderately coarse textured material during *flash floods*. These inclusions lie along the upper edge of areas mapped as this soil.

Range, irrigated cropland, and habitat for upland wildlife are the major uses of this soil. On range managed for cattle, the most valuable plants are winterfat and Indian ricegrass. In fields where the water is available, the soil can be prepared and used for irrigated crops. (Capability unit I-1, irrigated; VIIc-K, dryland)

Penoyer silt loam, slightly saline-alkali (Pu).—This extensive soil occupies a smooth, nearly level flood plain near Shadow Well in Penoyer Valley. In most places the slope is 1 percent or less. The soil has a profile that is similar to the one described as representative of the series, but it is slightly affected by salts and alkali in the uppermost 7 to 15 inches, a layer that is strongly alkaline. The soil is flooded periodically in summer when thunderstorms of high intensity produce heavy runoff. On the average, flooding occurs about 1 year in 10. In some areas, however, there may be runoff as often as several times a year, though it causes little damage. The vegetation consists of fourwing saltbush, greasewood, and some graymolly.

Included with this soil are eroded spots; small areas in which the A horizon is slightly saline-alkali fine sandy loam; and, near the upper edge of areas mapped as this soil, some gravelly spots. These inclusions make up about 5 percent of the total acreage.

This soil is in range that is used for limited grazing and as habitat for upland wildlife. Producing irrigated crops is feasible if the soil is leveled and permeability is increased, but dikes are needed to protect cropland from damage by overflow. Graymolly and fourwing saltbush are the most important plants on range managed for cattle. (Capability unit IIw-F, irrigated; VIIs-6, dryland)

Pintwater Series

The Pintwater series consists of very stony, moderately coarse textured soils that formed in material weathered in place from ignimbrite. These soils are on smooth to somewhat undulating, sloping to very steep hills and ridges in the Pahranagat Area.

Representative profile of a Pintwater soil, located about 800 feet east and 700 feet south of the west quarter corner of section 2, T. 8 S., R. 61 E.:

A11—0 to 1 inch, light brownish-gray (10YR 6/2) gravelly fine sandy loam, dark grayish brown (10YR 4/2) when moist; contains considerable mica, sanadine, and clear quartz crystals; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; practically devoid of plant roots; many very fine and fine interstitial pores; slightly to strongly effervescent; pH 8.5; abrupt, smooth boundary.

A12—1 to 4 inches, pale-brown (10YR 6/3, gravelly micaceous sandy loam, dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine and very fine roots; many fine and medium vesicular pores; strongly effervescent; pH 8.7; clear, smooth boundary.

C1ca—4 to 20 inches, very pale brown (10YR 7/3), very stony, slightly micaceous fine sandy loam, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant fine and very fine roots; many very fine and fine interstitial pores; violently effervescent; few to common, fine flecks of segregated lime, and limy stalactites on under side of pebbles; pH 8.5; clear, wavy boundary.

R—20 inches +, white (10YR 8/2), lime-coated, fragmental ignimbrite, brown (10YR 5/3) when moist; lime coatings in fractures and on the under side of loose rock fragments, commonly as stalactites.

The depth to bedrock ranges from 10 to 20 inches. If material from all the horizons is mixed, coarse fragments generally make up 60 to 80 percent of the mixture, and most of them are stones or cobblestones. From 30 to 60 percent of the surface is covered with coarse fragments, mostly pebbles or cobblestones. The texture throughout the profile is fine sandy loam or sandy loam. Except in places where sandy material has accumulated on the surface through wind action, the uppermost 1- to 4-inch layer has moderately developed vesicular porosity. A considerable amount of segregated lime coats the undersides of stones, cobblestones, and pebbles just above bedrock. The reaction is moderately alkaline or strongly alkaline throughout.

Drainage generally is good in these soils, but it is somewhat excessive in very steep areas. Runoff is medium or rapid, depending on slope. Permeability is moderate, natural fertility is low, and the available water capacity is very low. The soils have a shallow root zone. They are moderately or highly susceptible to erosion.

Pintwater rocky sandy loam, 12 to 45 percent slopes (PvE).—This extensive mapping unit lies mostly south of Ash Springs in Pahranagat Valley. In many places it is adjacent to the flood plain. The unit consists mainly of very stony, moderately coarse textured Pintwater soil and outcrops of ignimbrite rock. The soil has a profile similar to the one described for the series, and the outcrops are made up of many small and several large, almost vertical, irregularly shaped masses of ignimbrite. About 10 percent of the total acreage is occupied by areas in which rock crops out. The vegetation is mostly shadscale and Mormon-tea, and there is some galleta and annual fescue.

Included in areas mapped as this unit are many narrow drainage channels in which there are gravelly and cobbly soils that are similar to Carrizo soils. These inclusions cover about 5 percent of the total acreage.

The soil in this unit is in range, but its use by livestock is limited. It is not suitable for use as cropland, because it is too steep and too rocky. On range managed for cattle, the most important plants are galleta and shadscale. (Capability unit VIIs-7, dryland)

Playa

This land type consists of silty clay that lies as flat deposits on the undrained floor of the Penoyer Valley. The silty clay was derived from various kinds of rock. It extends to a depth of 8 or 9 feet and is underlain by fine sand, as can be seen in wells dug by hand in this material. It is very pale brown or light yellowish brown, is very strongly alkaline, and, in the upper few inches, is strongly saline-alkali. The concentration of salts and alkali decreases with increasing depth.

In years of abnormally heavy rainfall, or during rainstorms of high intensity in summer, water gathers in

the Playa and then is evaporated. Drainage is poor, permeability is very slow, and there is little or no erosion hazard.

This land type is essentially bare, and no use is made of it.

In the Penoyer survey area, Playa was mapped only in a Clay dune land-Playa association and in a Kawich-Playa complex. These mapping units are described under the heading "Clay Dune Land-Playa Association" and "Kawich Series."

Puddle Series

Soils of the Puddle series are affected by excess salts and alkali. They developed in alluvium underlain by material that apparently made up the shoreline of a prehistoric lake. The alluvium and the lake-laid material were derived from various kinds of rock, including tuff, limestone, dolomite, quartzite, shale, sandstone, and calcareous siltstone. These soils are on generally smooth, nearly level margins of alluvial fans in Penoyer Valley.

Representative profile of a Puddle soil, located about 1,050 feet north and 250 feet west of the east quarter corner of section 20, T. 2 S., R. 56 E.:

A1—0 to 2 inches, light-gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) when moist; weak, medium, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine roots; many very fine and fine vesicular pores; strongly effervescent, with a few lime nodules; pH 8.7; abrupt, smooth boundary.

C1—2 to 7 inches, similar to A1 horizon in color and texture; structureless (massive); slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine and fine roots; many very fine and fine tubular pores; strongly effervescent, with a few lime nodules; pH 8.7; abrupt, wavy boundary.

C2—7 to 13 inches, light fine sandy loam similar to A1 horizon in color; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many very fine and fine roots; many micro and very fine interstitial pores; strongly effervescent, with a few lime nodules; pH 8.0; abrupt, wavy boundary.

IIC3ca—13 to 22 inches, very fine sandy loam similar to the A1 horizon in color; weak, medium, prismatic structure; very hard when dry, firm when moist, slightly sticky and slightly plastic when wet; abundant very fine and fine roots, mostly between peds; common very fine and fine tubular pores; violently effervescent, with many flecks and mottles of white (10YR 8/1) lime on ped faces; a few lime nodules; pH 8.0; clear, wavy boundary.

IIC4ca—22 to 35 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist, nonsticky and slightly plastic when wet; plentiful very fine and fine roots in and between peds; common very fine and fine tubular pores; violently effervescent; common lime nodules 1 to 3 inches long; pH 8.9; clear, wavy boundary.

IIC5—35 to 60 inches +, light-gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) when moist; few fine veins of white lime and common to many, medium and coarse, brown (7.5YR 5/4) and (10YR 5/3) and reddish-brown (5YR 4/4) iron mottlings; weak, very coarse, prismatic structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; plentiful very fine and fine roots, mostly between peds; a few roots in peds; common very fine and fine tubular pores; strongly effervescent; contains few, comparatively long, slender lime nodules; pH 8.7.

Scattered on the surface are many lime nodules that appear to have formed in root channels. Most of these nodules range from 1/4 to 3/4 inch in diameter and from 1 to 3 inches in length. Many of them are round or have rounded bulges or nubbins with somewhat pointed protuberances.

In the IIC horizon of Puddle soils, the texture is very fine sandy loam, silt loam, and loam. Iron mottles occur in any horizon between the depths of 20 and 40 inches, and in places there are mottles and nodules of lime below a depth of 20 inches. Above the IIC horizon, the reaction is strongly alkaline or very strongly alkaline.

These soils now are well drained, but they were more poorly drained when the old lake existed. As the lake water evaporated, the water table was lowered to its present level, which is estimated to be more than 25 feet below the soil surface. Runoff is very slow on these soils, permeability is moderately slow, and the root zone is very deep. Natural fertility and the available water capacity are high. The erosion hazard is slight.

Puddle fine sandy loam (Pw).—This soil occupies long terraces that apparently formed the shoreline of an ancient lake on the floor of the Penoyer Valley. The surface is smooth and has an average slope of about 1 percent. Shadscale, littleleaf horsebrush, and fourwing saltbush are the principal plants, and there is some galleta and winterfat.

Included with this soil are a few, low, sandy hummocks and ridges built up by wind. Some of these are as much as 10 inches high. Also included, in a few shallow drainage channels, are small areas of Fang sandy loam, 0 to 2 percent slopes. These inclusions cover about 5 percent of the total acreage.

This soil is in range that provides limited grazing for livestock and habitat for upland wildlife. It can be developed as cropland if water is made available for irrigation. On range managed for cattle, the most important plants are winterfat, Indian ricegrass, and galleta. (Capability unit IIs–6, irrigated; VIIs–6, dryland)

Rock Land

Rock land (Rl) is extensive throughout the mountainous areas adjacent to Pahranagat Valley and Penoyer Valley. It consists of very shallow soil material and large outcrops of rock. Some of the rocks are igneous, either basic or acidic, and others are sedimentary. Slopes range from moderate in areas of tilted sedimentary rock to very steep in areas of nearly vertical bluffs. Little or no vegetation grows on this land.

Rock land is used as watershed areas, recreational areas, and habitat for wildlife. (Capability unit VIIIs–7, dryland)

Seaman Series

In the Seaman series are moderately coarse textured soils that developed in alluvium from various kinds of rocks, including ignimbrite and limestone, and from sandy lake sediments of the Tertiary geologic period. These soils occur in Pahranagat Valley. They occupy smooth or slightly convex, nearly level and gently sloping lower margins of alluvial fans, where the fans merge with flood plains.

Representative profile of a Seaman soil, located about 300 feet east and 800 feet north of the southwest corner of section 20, T. 5 S., R. 61 E.:

A1—0 to 4 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; structurelss (massive); soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant fine and very fine roots; many fine and very fine interstitial pores; many glass shards, particularly on the soil surface; strongly effervescent; pH 8.6; clear, smooth boundary.

C1—4 to 14 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine and very fine roots; many fine and very fine interstitial pores; contains many glass shards; strongly effervescent; pH 8.6; clear, smooth boundary.

C3—14 to 24 inches, light-gray (10YR 7/2) fine sandy loam, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine and very fine roots; many fine and very fine interstitial pores; contains many glass shards; strongly effervescent; pH 8.6; clear, smooth boundary.

C4—24 to 60 inches, light-gray (10YR 7/2) heavy fine sandy loam stratified with thin lenses of gravelly sandy loam, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few fine roots; many interstitial pores of various sizes; strongly effervescent; pH 8.6.

In some places the profile includes strata of coarse sandy loam. Thin strata of loamy sand or loamy fine sand may also be included. Gravel may occur in any horizon and make up as much as 40 percent of the volume. In some areas that are nearly as low as the flood plain, seepage from canals and excessive losses of irrigation water keep the water table high. In these areas the water table fluctuates between the depths of 36 and 72 inches most of the year, but it is highest in winter. In some areas the profile shows segregated lime in seams and in coatings on pebbles below a depth of 20 inches. In some areas the soils are slightly or strongly affected by soluble salts. The reaction is moderately alkaline or strongly alkaline.

The Seaman soils are well drained and have very slow runoff, moderately rapid permeability, and moderate available water capacity. Their natural fertility is moderate, and their root zone is very deep. Soil blowing is a slight or moderate hazard, depending on texture of the A horizon and position of the soil.

Most areas of Seaman soils are used for limited livestock grazing and as habitat for upland wildlife. A small acreage is used for irrigated crops. If additional water were made available, the soils could be cultivated to all crops suited to the climate.

Seaman fine sandy loam, hummocky, 0 to 2 percent slopes (SaA).—This soil is on nearly level alluvial fans in the vicinity of Lower Pahranagat Lake. Its surface is broken by old meandering channels into many hummocks 12 to 36 inches high. Except that the upper part of the soil is 9 to 15 inches of slightly saline fine sandy loam, the profile is similar to the representative one described. Erosion is a moderate hazard. The vegetation consists of quailbush, fourwing saltbush, and rubber rabbitbrush.

Included with this soil are small areas of Seaman sandy loam, 0 to 2 percent slopes, and Seaman loamy fine sand, 0 to 2 percent slopes. These inclusions make up about 10 percent of the total acreage.

This soil is used for range and as habitat for upland wildlife. All the acreage is suitable for cropping under irrigation. The slight salinity can easily be corrected by irrigating properly. Diversion channels and structures are needed to keep floodwater from damaging newly developed fields. On range managed for cattle, the most important plants are fourwing saltbush and quailbush. (Capability unit IIs-4, irrigated; VIIs-4, dryland)

Seaman loamy fine sand, 0 to 2 percent slopes (SbA).—This soil occupies three small areas on nearly level alluvial fans in the central Ash Springs watershed. Here, it has an average slope of about 1 percent. The upper part of the soil is loamy fine sand 8 to 14 inches thick, but in other respects the profile is similar to the one described for the series. Creosotebush and white bur-sage make up most of the plant cover, along with some shadscale, white burrobrush, and galleta.

Included is a small area south of Alamo in which the soil is slightly affected by salts. These could be easily removed through irrigation. If that soil were reclaimed, it would be used and managed in much the same way as this soil. Also included are small isolated pockets where the surface horizon is sandy loam. These inclusions account for about 20 percent of the total acreage.

Part of this soil is in range that furnishes limited grazing for livestock and habitat for upland wildlife. The rest is used for cultivated crops under irrigation. All the acreage is suited to irrigated crops. On range managed for cattle, shadscale and galleta are the most important plants. (Capability unit IIs-L, irrigated; VIIs-4, dryland)

Seaman sandy loam, 0 to 2 percent slopes (ScA).—This extensive soil occurs on many small alluvial fans on both sides of Pahranagat Valley from Hiko Lake to Lower Pahranagat Lake. It has a slightly convex surface and an average slope of about 1 percent. The risk of erosion is slight. Creosotebush and white bur-sage make up most of the vegetation, and there are some shadscale and white burrobrush.

Included with this soil, near the lower edge of alluvial fans, are small areas that are slightly affected by salts. Also included, at the upper edge of the fans, are isolated gravelly spots. These inclusions cover about 10 percent of the total acreage.

Most of this soil is used to provide limited grazing for livestock and habitat for upland wildlife. About a third of the acreage is cropped under irrigation. All of it is suitable for cultivation if water is made available. On range managed for cattle, the most important plants are shadscale and galleta. (Capability unit IIs-4, irrigated; VIIs-4, dryland)

Seaman sandy loam, 2 to 4 percent slopes (ScB).—This soil lies on many small alluvial fans between Alamo and Hiko Spring in Pahranagat Valley. The average slope is about 3 percent, and the hazard of erosion is slight. The vegetation is mainly creosotebush and white bur-sage, together with some shadscale, white burrobrush, and galleta.

Included with this soil, near Brownie Springs, is an area of Seaman gravelly sandy loam that has slopes of 2 to 4 percent and makes up about 20 percent of the total

acreage. It is used and managed in about the same way as Seaman sandy loam, 2 to 4 percent slopes.

Most of this soil is in range that provides limited grazing for livestock and habitat for upland wildlife. On about a third of the acreage, where water is now available, cultivated crops are grown. A large acreage could be leveled and irrigated if water could be obtained, but many dryland areas are so small or so irregularly shaped that they would be difficult to bring into existing irrigated fields. On range managed for cattle, the most important plants are shadscale and galleta. (Capability unit IIe-1, irrigated; VIIs-4, dryland)

Seaman sandy loam, water table, slightly saline, 0 to 2 percent slopes (SdA).—This soil occurs in many places south of Crystal Spring on the lower parts of small alluvial fans. In these places it is influenced by ground water from adjoining wet soils on the flood plain. Consequently, drainage is somewhat poor. The water table fluctuates between the depths of 36 and 72 inches most of the year. In addition, the soil is slightly affected by salts in the upper 6 to 9 inches. Erosion is a slight hazard. The vegetation consists mainly of rubber rabbitbrush, quailbush, and fourwing saltbush.

Included are small areas, slightly higher than areas of this soil, that are strongly affected by salts in the surface horizon. Also included, along the lower edge of alluvial fans, are small areas of Pahranagat soils. These inclusions make up about 15 percent of the total acreage.

This soil is used mostly as range and as habitat for upland wildlife. Limited grazing is obtained in areas used as range. If these areas are managed for cattle, the most important plants are four-wing saltbush and quailbush. Under irrigation, all the acreage is suited to cultivated crops, but leveling is needed to prepare the soil for use. (Capability unit IIw-2, irrigated; VIIw-6, dryland)

Seaman sandy loam, water table, strongly saline, 0 to 2 percent slopes (SeA).—This soil is on several alluvial fans south of Hiko, where ground water from adjacent soils on the flood plain seeps into the lower horizons. As a result, drainage is somewhat poor. The water table fluctuates between the depths of 36 and 72 inches most of the year, but it is highest in winter. The upper part of the soil, to a depth of 4 to 9 inches, is strongly affected by salts. Except after a heavy rain, the surface is covered with a crust of white salt. Erosion is a slight hazard. Quailbush, four-wing saltbush, and rubber rabbitbrush are the principal plants.

Included with this soil, along the lower edge of alluvial fans, are small areas of Lahontan fine sandy loam, water table variant. These inclusions make up about 10 percent of the total acreage.

This soil is used to a limited extent as range, and it provides habitat for upland wildlife. All the acreage is suited to cultivated crops, though some leveling is needed to prepare fields for irrigation. On range used by cattle, the most important plants are four-wing saltbush and quailbush. (Capability unit IIw-2, irrigated; VIIw-6, dryland)

Sierocliff Series

The Sierocliff series consists of very gravelly, moderately coarse textured soils that have a hardpan indurated with lime. These soils lie on moderately sloping to strongly sloping alluvial fans in Penoyer Valley. They developed in gravelly alluvium derived mainly from limestone, dolomite, and quartzite but partly from sandstone and shale.

Representative profile of a Sierocliff soil, located about 525 feet north and 200 feet west of the east quarter corner of section 23, T. 1 N., R. 56 E.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) extremely stony fine sandy loam (25 percent stones), dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine and very fine roots; many fine and very fine and a few medium interstitial pores; strongly effervescent; pH 8.6; abrupt, smooth boundary.

C1—3 to 8 inches, very pale brown (10YR 7/3) gravelly loam, dark brown (10YR 4/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few medium roots, and abundant fine and very fine roots; few very fine and many fine interstitial pores; violently effervescent; pH 8.6; clear, wavy boundary.

C2—8 to 15 inches, light-gray (10YR 7/2) very gravelly fine sandy loam (75 percent gravel), brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many very fine and fine interstitial pores; violently effervescent; pH 8.7; clear, wavy boundary.

C3ca—15 to 22 inches, white (10YR 8/2) very gravelly fine sandy loam (75 percent gravel), light brownish gray (10YR 6/2) when moist; massive; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; abundant very fine roots, and few fine and medium roots; many micro, very fine, and fine interstitial pores; violently effervescent; pH 8.8; abrupt, wavy boundary.

C4cam—22 to 25 inches, white (N 8/0), indurated lime hardpan (30 percent gravel), light gray (10YR 7/2) when moist; weak, thick, platy structure, the platelets having laminar cross sections; few medium roots in fractures; no pores visible in top part but many micro pores in lower part; violently effervescent; pH 8.8; clear, wavy boundary.

IIC5cam—25 to 33 inches, light-gray (10YR 7/1), strongly lime-cemented, very gravelly hardpan (80 percent gravel), grayish brown (10YR 5/2) when moist; massive; very few fine and very fine roots; many micro and very fine interstitial pores; violently effervescent; pH 8.8; clear, wavy boundary.

IIC6—33 to 43 inches +, light-gray (10YR 7/2) very gravelly loamy sand (85 percent gravel), sand grains are light brownish gray (10YR 6/2) and brownish gray (10YR 5/2) when moist; single grain; loose when dry or moist; very few, very fine roots; many fine and very fine interstitial pores; violently effervescent; pH 8.8.

The texture above the hardpan is dominantly fine sandy loam or sandy loam, but in some places it is loam. All of the material is gravelly. The content of coarse fragments above the hardpan ranges from 40 to 80 percent. The fragments are mostly pebbles, but in some places cobblestones or stones make up as much as 30 percent of the coarse fragments. If the material above the hardpan is mixed, more than 50 percent of it is coarse fragments. The content of lime in the C3ca horizon is variable. In some places there is enough segregated lime to give this horizon a marly appearance, but in others the lime only coats the coarse fragments. The hardpan ranges from 20 to 30 inches in depth and from 10 to 24 inches in thickness. It is indurated in the upper 3 to 6

inches. The profile is moderately alkaline or strongly alkaline throughout.

These soils are well drained, and they have medium runoff and very slow permeability. The inherent fertility is low, and the available water capacity is very low. Because of the hardpan, the root zone is only moderately deep. Erosion is a moderate hazard.

Sierocliff extremely stony very fine sandy loam, 4 to 12 percent slopes (SfC).—This soil occurs in a large area on moderately sloping and strongly sloping alluvial fans adjacent to the Worthington Mountains in the Penoyer Area. On an average, the slope is about 7 percent. The surface is slightly convex, except where it is dissected by a few intermittent drainage channels 4 to 12 feet deep. The vegetation is a sparse stand of black sagebrush, galleta, and Mormon-tea.

Included near the northern edge of the area mapped as this soil are several tracts of Nevoyer gravelly loam and of rock outcrops. Also included, on short and very steep side slopes in the drainage channels, are areas of gravelly Cliffdown soils. These inclusions make up about 15 percent of the total acreage.

This soil is in range that provides limited grazing for livestock. It is not suitable for cultivation or for irrigation, because it is extremely stony and has very low available water capacity. On range managed for cattle, the most important plants are Indian ricegrass, galleta, and black sagebrush. (Capability unit VIIs–7, dryland)

Silent Series

The Silent series consists of moderately fine textured soils that have a hardpan cemented with lime. These soils developed in alluvium derived mainly from limestone but partly from dolomite, quartzite, shale, and sandstone. They occur on smooth to somewhat convex, gently sloping to strongly sloping alluvial fans in Penoyer Valley.

Representative profile of a Silent soil, located about 1,500 feet north and 1,420 feet east of the southwest corner of section 31, T. 3 S., R. 56 E.:

A1—0 to 4 inches, light-gray (10YR 7/2) gravelly sandy loam (15 percent gravel), grayish brown (10YR 5/2) when moist; weak, thin and medium, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine and medium roots; many very fine and fine and a few medium vesicular pores; violent effervescence; pH 8.5; abrupt, wavy boundary.

B21t—4 to 8 inches, light-brown (7.5YR 6/4) light clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant fine and few medium roots; many very fine and fine tubular pores; common thin clay films in pores and on ped faces; violent effervescence; pH 8.5; gradual, smooth boundary.

B22tca—8 to 12 inches, light-brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, medium and coarse, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; abundant very fine roots; many very fine and fine tubular pores, and few medium tubular pores; common thin clay films on ped faces and thin continuous clay films in pores; violent effervescence; common, fine and medium segregations of white lime; pH 8.5; clear, wavy boundary.

B3tca—12 to 17 inches, mottled white (10YR 8/1) and light-gray (10YR 7/2) gravelly light clay loam, pale brown (10YR 6/3) and very pale brown (10YR 7/3) when moist; structureless (massive); slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; plentiful very fine roots; common fine tubular pores; violent effervescence; weak lime-cemented lenses in places; pH 8.8; abrupt, wavy boundary.

C1cam—17 to 30 inches +, white (10YR 8/1), indurated lime-cemented hardpan, light brownish gray (10YR 6/2) when moist; massive; devoid of roots and without visible pores; the uppermost 1/4 to 1/2 inch of this horizon is dense and laminated, and the surface is troweled; violent effervescence; pH 8.8.

The A1 horizon has platy structure or is structureless (massive), and it has a moderately developed vesicular porosity. The gravel content in the A1 horizon ranges from 10 to 40 percent. In the B horizon the texture is heavy loam or sandy clay loam in some places. This horizon has subangular blocky or prismatic structure in the upper part. The lower part of the B horizon contains a considerable amount of segregated lime and is weakly cemented in spots. The depth to the hardpan ranges from 15 to 22 inches. The profile is moderately alkaline or strongly alkaline throughout.

Drainage is good in the Silent soils. Runoff is slow, permeability is very slow, and the available water capacity is very low. The soils are low in natural fertility and have a shallow root zone. They are moderately susceptible to erosion.

These soils are used only as range that provides limited grazing for livestock. Because of the shallow root zone, they are not suitable for cultivation or for irrigation.

Silent gravelly loam, 2 to 12 percent slopes (SgC).—This soil lies in an extensive area at the foot of the Timpahute Range near State Route 25 in Penoyer Valley. Here, it occupies gently sloping to strongly sloping alluvial fans that have an average slope of about 7 percent. Except for its A horizon of gravelly loam, which is moderately alkaline, this soil has a profile similar to the one described for the series. Shadscale, galleta, and bud sagebrush make up most of the plant cover. In addition, there is some winterfat.

Included with this soil are areas of very deep, gravelly Cliffdown soils that occur in deep drainage channels dissecting the alluvial fans. Also included are very steep terrace escarpments adjoining the channels and small cobbly areas near the Timpahute Range. These inclusions cover about 10 percent of the total acreage.

This soil is used to provide limited grazing for livestock. It is not suitable for cropping or irrigating, because the root zone is shallow and the available water capacity is very low. On range managed for cattle, the most important plants are galleta, bud sagebrush, and winterfat. (Capability unit VIIs-8, dryland)

Silent gravelly sandy loam, 2 to 4 percent slopes (ShB).—This soil occupies a smooth, gently sloping alluvial fan that is adjacent to State Route 25 and lies below the Timpahute Range. The average slope is about 3 percent. Shadscale, galleta, winterfat, and bud sagebrush, growing in sparse stands, form the plant cover.

This soil is in range that furnishes limited grazing for livestock. It is not suitable for cultivation or irrigation, because the root zone is shallow and the available water capacity is very low. (Capability unit VIIs–8, dryland)

Silent very rocky loam, 4 to 12 percent slopes (SkD).—This mapping unit is in areas that are higher than those of other Silent soils in Penoyer Valley. It occurs on moderately sloping and strongly sloping alluvial fans adjoining the Timpahute Range. The surface is convex, and the average slope is near 11 percent. About 80 percent of the unit is Silent gravelly loam, and 20 percent is volcanic rock that lies in ridges and outcrops on which there is practically no soil material. Except for its gravelly loam A horizon, the soil is similar to the one described in the representative profile. The vegetation consists of shadscale, galleta, winterfat, and bud sagebrush in sparse stands.

About 5 percent of the total acreage is included spots of stony Silent soils adjacent to the volcanic ridges and outcrops.

This mapping unit is used for limited livestock grazing. It is not suitable for use as cropland, because it contains scattered outcrops of rock and because the soil is shallow and has very low available water capacity. On range managed for cattle, the most valuable plants are galleta, bud sagebrush, and winterfat. (Capability unit VIIs–7, dryland)

Silverbow Series

The Silverbow series consists of strongly sloping, very stony, moderately fine textured soils that developed on colluvial slopes of low-lying andesitic foothills in Penoyer Valley. These soils contain a hardpan cemented with silica and lime.

Representative profile of a Silverbow soil, located about 1,050 feet south and 1,050 feet west of the east quarter corner of section 2, T. 3 S., R. 54 E.:

A1—0 to 2½ inches, light brownish-gray (10YR 6/2) extremely stony and gravelly very fine sandy loam, dark brownish gray (10YR 4/2) when moist; weak, fine, granular structure and, in places, weak, thin to medium, platy material that breaks readily to fine granules; soft when dry, friable when moist, nonsticky and nonplastic when wet; plentiful fine roots; many fine tubular and interstitial pores, and few fine vesicular pores; slight effervescence; pH 8.5; clear, smooth boundary.

B2t—2½ to 8 inches, brown (7.5YR 5/4) very stony clay loam, brown (7.5YR 5/4) when moist; moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; abundant very fine and fine roots; many fine tubular pores; thin continuous clay films on ped faces and in pores; slight effervescence; pH 8.5; clear, smooth boundary.

B3tca—8 to 13 inches, brown (10YR 5/3) very stony clay loam, brown (10YR 5/3) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist, sticky and plastic when wet; plentiful very fine and fine roots; many fine tubular pores; few thin patchy clay films on ped faces; generally strong effervescence, but violent effervescence where common, coarse, light-gray (10YR 7/2) lime segregations occur; pH 8.5; clear, wavy boundary.

C1sicam—13 to 16 inches, white (10YR 8/2), very stony, indurated, silica-lime cemented hardpan, light gray (10YR 7/2) when moist; massive; very few very fine roots in fractures of the hardpan; upper surface laminar; violent effervescence; pH 8.5; clear, wavy boundary.

C2sicam—16 to 36 inches, white (10YR 8/2), strongly to weakly cemented colluvial stones and boulders, light gray (10YR 7/2) when moist; massive; difficult to remove because of size, interlocking of coarse fragments, and cementation.

A stony erosion pavement, consisting of somewhat angular cobblestones and stones, covers 30 to 50 percent of the surface of these soils. In places where the A1 horizon has platy structure, a moderate vesicular porosity occurs. The texture of the B horizon is dominantly clay loam but, in some places, is sandy clay loam. Coarse fragments, mostly stones or cobblestones, make up 50 to 80 percent of the volume in the B horizon. The indurated upper hardpan (C1sicam horizon) ranges from 2 to 5 inches in thickness. Andesitic bedrock lies at a depth of more than 30 inches. The reaction throughout the profile ranges from mildly alkaline to strongly alkaline.

These soils are well drained and have medium runoff, very slow permeability, and very low available water capacity. Their root zone is shallow, and their natural fertility is low. The hazard of erosion is moderate.

Silverbow extremely stony very fine sandy loam, 8 to 12 percent slopes (SlD).—This soil occupies many small to large areas in the foothills on the western rim of Penoyer Valley. The relief generally is smooth, and the average slope is about 11 percent. The vegetation is a sparse stand of Anderson wolfberry, Mormon-tea, littleleaf horsebrush, spiny hopsage, and some buckwheat, galleta, and Indian ricegrass.

Small areas of rubble and outcrops of rock are included. These make up about 5 percent of the total acreage.

This soil is in range, but it provides only a little forage for livestock. It also is used as habitat by upland wildlife. Because the soil is so stony and so shallow, it is not suitable for cropping or irrigation. On range managed for cattle, the most important plants are Indian ricegrass, desert needlegrass, and galleta. (Capability unit VIIs–7, dryland)

Slickens

Slickens (Sm) are refuse materials, or tailings, that were deposited during the processing of tungsten ore. They occupy a long, gently sloping area below the abandoned Lincoln Mine in Penoyer Valley. Slickens consist of grayish-brown very fine sand that is 20 to more than 60 inches deep and is strongly alkaline.

This land is well drained and has very slow runoff, moderately rapid permeability, low available water capacity, and low inherent fertility. It supports little or no vegetation, and the material is moderately susceptible to erosion, particularly to blowing. In the wash north of Timpahute Well, a considerable amount of material has been shifted or carried away by wind.

No use is made of this land. (Capability unit VIIIs–6, dryland)

Specter Series

In the Specter series are very gravelly, moderately coarse textured soils that contain a hardpan cemented with lime and silica. These soils formed in alluvium derived mainly from tuff. They occupy gently sloping to strongly sloping alluvial fans in Penoyer Valley.

Representative profile of a Specter soil, located about 1,420 feet north and 800 feet west of the south quarter corner of section 11, T. 2 S., R. 54 E.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) gravelly loam (35 percent gravel), dark grayish brown (10YR 4/2) when moist; structureless (massive); soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine roots; many fine and medium vesicular pores; slightly effervescent; pH 8.4; clear, smooth boundary.

C1—2 to 11 inches, light brownish-gray (10YR 6/2) gravelly fine sandy loam (30 percent gravel), dark grayish brown (10YR 4/2) when moist; structureless (massive); soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many very fine and fine tubular pores; slightly effervescent; pH 8.5; abrupt, smooth boundary.

C2—11 to 17 inches, light brownish-gray (10YR 6/2) very gravelly sandy loam (60 percent gravel, most of the pebbles less than ½ inch in diameter), dark brown (10YR 4/3) when moist; single grain; loose when dry or moist; abundant very fine and fine roots; many very fine interstitial pores; very slightly effervescent; pH 9.4; abrupt, smooth boundary.

C3ca—17 to 30 inches, light brownish-gray (10YR 6/2) very gravelly sandy loam (60 to 65 percent gravel), dark brown (10YR 4/3) when moist; single grain; loose when dry or moist; plentiful very fine and fine roots; many very fine and fine interstitial pores; slightly effervescent, but strongly effervescent where lime occurs on under side of pebbles; pH 8.6; abrupt, wavy boundary.

C4sicam—30 to 51 inches, white (10YR 8/1), indurated, silica-lime cemented hardpan, light gray (10YR 7/2) when moist; few very fine roots matted in cracks; many micro interstitial pores in lower part; violently effervescent; pH 8.4; abrupt, wavy boundary.

IIC5—51 to 60 inches +, very pale brown (10YR 7/3) gravelly loamy sand, brown (10YR 5/3) when moist; massive; soft when dry, with a few ¼- to 1-inch lenses of slightly hard material especially high in calcium carbonate; very friable when moist, nonsticky and nonplastic when wet; no roots; common very fine interstitial pores; violently effervescent; pH 8.4.

Pebbles cover 50 to 80 percent of the soil surface. In some areas wind has deposited sandy material 2 to 4 inches thick at the base of shrubs. The horizons above the hardpan are gravelly and are dominantly sandy loam or fine sandy loam, but in places their texture includes light loam. The content of gravel ranges from 15 to 40 percent between the surface and a depth of 11 inches, and from 55 to 75 percent below 11 inches. Most of the pebbles are less than 1 inch across. The hardpan ranges from 24 to 36 inches in depth and from 15 to 25 inches in thickness. It is laminated on the upper surface. Throughout the profile the reaction is midly alkaline to very strongly alkaline, but generally it is most alkaline above the pan.

The Specter soils are somewhat excessively drained. Their permeability and runoff are very slow, and their available water capacity is very low. Natural fertility is low. The root zone is moderately deep. Erosion is a moderate hazard.

Specter gravelly loam, 2 to 12 percent slopes, eroded (SnC2).—This soil lies on gently sloping and moderately sloping alluvial fans north of Black Rock in Penoyer Valley. The average slope is about 9 percent, and the surface generally is smooth. Especially at the higher elevations, however, the soil is dissected by many drainage channels 1 to 10 feet deep. Periodically, these channels are washed by runoff from higher lying soils. The vegetation is sparse and consists of shadscale, bud sagebrush, galleta, littleleaf horsebrush, Mormon-tea, and Indian ricegrass.

Included with this soil, most commonly in the upper reaches of the fans, are spots of stony Specter soils. Also included are steep and very steep escarpments adjacent to the drainage channels, and in places there are hummocks of sandy material deposited by wind at the base of shrubs. These inclusions account for about 10 percent of the total acreage.

This soil is in range that is used for limited grazing. Because it is gravelly and has very low available water capacity, it is not suitable for developing as irrigated cropland. Indian ricegrass and galleta are the most important plants on range managed for cattle. (Capability unit VIIs-8, dryland)

Stumble Series

The Stumble series consists of gravelly, coarse-textured soils that developed on fans and terraces laid down by streams. The stream-laid material was derived from tuff, andesite, and basalt. Stumble soils occur on smooth, nearly level, slightly convex ridges in the Penoyer Area.

Representative profile of a Stumble soil, located about 500 feet south and 500 feet west of the north quarter corner of section 15, T. 4 S., R. 54 E.:

A1—0 to 6 inches, light brownish-gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) when moist; structureless (single grain); loose when dry or moist; abundant fine roots; very porous; noneffervescent; pH 8.3; clear, smooth boundary.

C1—6 to 14 inches, light brownish-gray (10YR 6/2) loamy sand, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many fine and very fine tubular pores; noneffervescent; pH 8.3; clear, smooth boundary.

C2ca—14 to 29 inches, light brownish-gray (10YR 6/2) loamy sand, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many fine and very fine tubular pores; strongly effervescent; pH 8.3; clear, smooth boundary.

C3—29 to 50 inches +, light brownish-gray (10YR 6/2) gravelly loamy sand, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine and very fine roots; many very fine interstitial pores; slightly effervescent; pH 8.4.

These soils are dominantly loamy sand or loamy fine sand in which the gravel content ranges from 0 to 40 percent. In some places they are stratified with layers of fine sand or sand. Some of these layers are gravelly. In some places between the depths of 10 and 26 inches, there are fine filaments of lime, and in some places that are gravelly, the pebbles are coated with lime. Finer textured material is at a depth of more than 40 inches. The profile is moderately alkaline or strongly alkaline.

These somewhat excessively drained soils have very slow runoff, are rapidly permeable, and have low available water capacity. They are low in natural fertility but have a very deep root zone. The hazard of erosion is moderate.

The Stumble soils are used for limited livestock grazing and as habitat for some kinds of upland wildlife. If water were made available for irrigation, the soils could be cultivated and locally suited crops could be grown.

Stumble loamy sand (St).—This soil is in several large areas scattered through the western half of Penoyer Valley. It has a smooth surface and an average slope of about 1 percent. The vegetation consists of littleleaf horsebrush, low Douglas rabbitbrush, fourwing saltbush, winterfat, Indian ricegrass, and annual plants growing in sparse stands.

Included are areas where the upper part of the soil is 4 to 12 inches of hummocky sand that was deposited and then reworked by wind. Also included are small areas in which the surface is covered with gravel. These inclusions make up about 10 percent of the total acreage.

This soil is used to a limited extent for range, and it provides habitat for some kinds of upland wildlife. It can be prepared and used for irrigated crops if water is made available. On range managed for cattle, the most important plants are Indian ricegrass, desert needlegrass, and winterfat. (Capability unit IIIs–L, irrigated; VIIs–L, dryland)

Stumble loamy sand, deep (Su).—This soil lies along the smooth, nearly level margins of old alluvial fans in the southern part of Penoyer Valley. It has a profile somewhat similar to the one described for the series, but it is underlain by finer textured, slowly permeable soil material at a depth of 40 to 58 inches. The material resembles that in the Tickapoo soils. This Stumble soil is strongly alkaline in the A horizon. The available water capacity is low, though it is slightly higher than in other soils of the series. Galleta and littleleaf horsebrush make up most of the plant cover, and there is some Anderson wolfberry and spiny hopsage.

This soil is used to provide limited grazing for livestock and habitat for some kinds of upland wildlife. On range managed for cattle, the most important plants are Indian ricegrass, desert needlegrass, and galleta. If water is made available, the soil is suitable for use as irrigated cropland. Care in irrigation would be necessary, however, to avoid building up a perched water table that would reduce yields and shorten the life of deep-rooted crops. (Capability unit IIIs–L, irrigated; VIIs–L, dryland)

Sundown Series

The Sundown series consists of coarse-textured soils that lie on nearly level to gently sloping alluvial fans and low terraces adjacent to channels of intermittent streams in Penoyer Valley. These soils formed in alluvium derived from many kinds of rocks, including tuff, limestone, dolomite, quartzite, sandstone, and a small amount of obsidian.

Representative profile of a Sundown soil, located about 250 feet west and 600 feet south of the center of section 5, T. 3 S., R. 56 E.:

A1—0 to 3 inches, light-gray (10YR 7/2) loamy fine sand, brown (10YR 5/3) when moist; very weak, thin, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine and fine roots; many very fine vesicular pores, and many very fine and fine interstitial pores; strongly effervescent; pH 8.6; clear, smooth boundary.

C1—3 to 10 inches, light-gray (10YR 7/2) heavy loamy sand, brown (10YR 5/3) when moist; structureless (massive); slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many very fine and fine tubular pores; strongly effervescent; pH 8.6; clear, smooth boundary.

C2—10 to 19 inches, light-gray (10YR 7/2) loamy fine sand, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and fine roots; many very fine and fine interstitial pores; strongly effervescent; pH 8.6; clear, smooth boundary.

C3—19 to 47 inches, light-gray (10YR 7/2) loamy fine sand, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant very fine and plentiful fine roots; common very fine tubular pores, and many very fine and fine interstitial pores; violently effervescent; pH 9.2; abrupt, smooth boundary.

IIC4—47 to 52 inches +, very pale brown (10YR 7/3) light sandy clay loam (10 percent fine gravel), yellowish brown (10YR 5/4) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine roots; many very fine vesicular pores, and few fine tubular pores; violently effervescent; pH 9.0.

These soils are somewhat stratified above the IIC4 horizon, and in places there are layers of sand or fine sand. But if the material in the A1, C1, C2, and C3 horizons were mixed, it would be dominantly loamy fine sand or loamy sand in texture. Gravel makes up 5 to 75 percent of the soil mass in the upper 6 to 14 inches, and the gravel content ranges from 0 to 40 percent in the lower horizons. The depth to the IIC4 horizon ranges from 40 to more than 60 inches. This horizon is light sandy clay loam, sandy clay loam, or heavy loam. In places where lime occurs, it generally is disseminated, but lime coatings may be present below a depth of 24 inches. The reaction ranges from moderately alkaline to very strongly alkaline. Alkalinity is strongest below a depth of 18 inches.

The Sundown soils are somewhat excessively drained. They have very slow runoff, are rapidly permeable, and have low to moderate available water capacity. Their natural fertility is low or moderate, and their root zone is very deep. The hazard of soil blowing is slight or moderate, depending on the texture of the A1 and C1 horizons.

These soils are used only for limited livestock grazing and as habitat for upland wildlife. If water were made available for irrigation, they could be used for cultivated crops suited to the climate.

Sundown loamy sand, 0 to 2 percent slopes, eroded (SvA2).—This soil lies in a large area on a smooth alluvial terrace southeast of Sand Spring in Penoyer Valley. Slopes, on an average, are about 1 percent. The surface is broken by a few shallow drainage channels and by many hummocks and ridges less than 18 inches high. The hummocks and ridges consist of sandy material piled up by wind. Natural fertility and the available water capacity are low. Soil blowing is a moderate hazard. Dominant in the plant cover are galleta, winterfat, fourwing saltbush, and littleleaf horsebrush. Also present are Indian ricegrass and low Douglas rabbitbrush.

Included with this soil are small areas in which there is little or no erosion. Also included are small gravelly

areas. These inclusions occupy about 10 percent of the total acreage.

This soil is used for limited livestock grazing and as habitat for some kinds of upland wildlife. It is suitable for use as irrigated cropland if water is made available. On range managed for cattle, the most important plants are Indian ricegrass, desert needlegrass, and winterfat. (Capability unit IIIs–L, irrigated; VIIs–L, dryland)

Sundown sandy loam, 0 to 2 percent slopes (SwA).—This soil is in narrow, relatively long areas southeast of Sand Spring, where it adjoins areas of Sundown loamy sand, 0 to 2 percent slopes, eroded. Except for its sandy loam texture in the upper 7 to 10 inches, this soil has a profile similar to that described for the series. Natural fertility and the available water capacity are moderate. The hazard of erosion is slight. Galleta, bud sagebrush, and shadscale are the principal plants, but winterfat and Indian ricegrass also occur.

Included with this soil are small areas of loamy sand that lie next to larger areas mapped as Sundown loamy sand. Also included are small areas where soil blowing has thinned the profile. These inclusions make up about 10 percent of the total acreage.

This soil is used to provide limited grazing for livestock and habitat for some kinds of upland wildlife. It can be developed as cropland if water is made available for irrigation. Indian ricegrass, winterfat, and galleta are the most important plants on range managed for cattle. (Capability unit IIIs–4, irrigated; VIIs–4, dryland)

Sundown very gravelly loamy sand, 2 to 4 percent slopes, eroded (SyB2).—This soil occurs on gently sloping alluvial fans, where it is adjacent to, but somewhat higher than, Sundown loamy sand. The surface is broken by many drainage channels 2 to 6 feet deep, and these are periodically washed by concentrations of runoff from higher lying soils. The upper part of this eroded soil is 6 to 14 inches of very gravelly loamy sand, but in other respects the profile is similar to the representative one described, though it contains more gravel than that of other Sundown soils. In the upper 6- to 14-inch layer, the content of gravel ranges from 60 to 75 percent. Below this layer the gravel content ranges from 10 to 40 percent but, on the average, is about 20 percent. The available water capacity and the inherent fertility are low. Erosion is a moderate hazard. Galleta, winterfat, bud sagebrush, shadscale and Indian ricegrass make up the plant cover and grow in sparse stands.

Included with this soil, in places near Sundown loamy sand, are patches of gravelly and nongravelly Sundown soils. These inclusions cover about 15 percent of the total acreage.

This soil is in range, though its use for grazing is limited. The soil is too gravelly for cultivation or for irrigation. On range managed for cattle, the most valuable plants are Indian ricegrass, winterfat, and galleta. (Capability unit VIIs–L, dryland)

Theriot Series

The Theriot series consists of very stony, medium-textured soils that developed in residuum from dolomitic limestone. These soils occupy broken, very steep ridges and side slopes in the mountains and rugged hills of the Pahranagat Area.

Representative profile of a Theriot soil, located about 300 feet south and 200 feet east of the northwest corner of section 6, T. 6 S., R. 61 E.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) stony loam (stones are mostly angular and range up to 12 inches in diameter), dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; abundant fine and very fine roots; common, very fine to medium interstitial pores; violently effervescent; pH 8.6; clear, smooth boundary.

C—3 to 14 inches, very pale brown (10YR 7/3) very stony loam, brown (10YR 5/3) when moist; many stones in the lower part of this horizon have stalactites of calcium carbonate that range from 1/8 to 1/4 inch in length; structureless (massive); slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; violently effervescent; pH 8.6; abrupt, wavy boundary.

R—14 inches +, very hard dolomitic limestone bedrock.

The A1 horizon is structureless (massive) in some places. The content of coarse fragments ranges from 50 to 80 percent. Most of the fragments are stones, though in some areas they are cobblestones or pebbles. Just above bedrock there is a considerable amount of segregated lime that coats the lower side of coarse fragments. In thickness the coatings range from a trace to 3/8 inch. In a few areas the C horizon includes thin (as much as 1 inch thick) zones that are weakly cemented with lime. Throughout the profile the reaction is moderately alkaline or strongly alkaline.

Drainage is good in the Theriot soils. Runoff is medium or rapid, depending on slope. Permeability is moderate, and the available water capacity is very low. The soils are low in natural fertility and have a shallow root zone. They are moderately erodible if left unprotected.

Theriot extremely rocky loam, 30 to 100 percent slopes (TaF).—This soil is on steep to extremely steep side slopes in the Hiko Range along the eastern side of the Pahranagat Area, northward from Ash Springs. The vegetation is a thin cover of shadscale, white bur-sage, spiny menodora, datil yucca, cactus, and Mormon-tea.

Included are areas of rock outcrops and almost vertical cliffs of dolomitic limestone that make up about a third of the total acreage. Also included, in the vicinity of Hiko Spring and Ash Springs, are a few small areas of tufa rock, which formed as a deposit from spring water.

This soil is used as range that provides limited grazing for livestock. Because it is steep, shallow, and very stony and rocky, the soil is not suitable for use as irrigated cropland. The only important plant on range managed for cattle is shadscale. (Capability unit VIIs–7, dryland)

Tickapoo Series

The Tickapoo series consists of fine-textured soils that are underlain by a hardpan cemented with silica. These soils developed in alluvium on nearly level to strongly sloping alluvial fans in Penoyer Valley. The alluvium was derived principally from ignimbrite.

Representative profile of a Tickapoo soil, located about 1,000 feet south and 870 feet east of the northwest corner

of section 9, T. 4 S., R. 54 E. (laboratory data for this soil are given in tables 9 and 10):

A1—0 to 3 inches, light-gray (10YR 7/2) sandy loam (10 percent gravel), brown (10YR 5/3) when moist; weak, thick, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine and fine roots; many very fine and fine vesicular pores, and few medium vesicular pores; no effervescence in most of this horizon, but slight effervescence in spots; pH 8.5; abrupt, smooth boundary.

B1t—3 to 5 inches, light-gray (10YR 7/2) sandy clay loam, yellowish brown (10YR 5/4) when moist; weak, fine, subangular blocky structure to weak, fine, granular structure; slightly hard when dry, friable when moist, sticky and plastic when wet; plentiful fine and very fine roots; many very fine and fine interstitial pores; common thin and few moderately thick clay films on ped faces; no effervescence; pH 8.2; clear, wavy boundary.

B21t—5 to 11 inches, brown (7.5YR 5/4) sandy clay, dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure; slightly hard when dry, friable when moist, sticky and plastic when wet; plentiful fine and very fine roots, and few medium roots; many fine and very fine tubular pores and many cracks between peds; many moderately thick clay films on ped faces and in pores; no effervescence; pH 8.2; clear, wavy boundary.

B22t—11 to 17 inches, brown (7.5YR 5/4) sandy clay, dark brown (7.5YR 4/4) when moist; many, medium and coarse, faint, pinkish-white (7.5YR 8/2) lime filaments; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; abundant fine and very fine roots; few very fine and fine tubular pores, and many fine interstitial pores; common thin clay films on ped faces, as coatings on sand grains, and as bridges between sand grains; strong effervescence; pH 8.5; abrupt, wavy boundary.

IIC1sica—17 to 22 inches, very pale brown (10YR 7/3) very gravelly coarse sandy loam (60 percent gravel) that contains randomly oriented, strongly silica-cemented lenses 1/32 inch thick, brown (10YR 5/3) when moist; massive; matrix is very hard and slightly hard when dry, firm and friable when moist, nonsticky and nonplastic when wet; abundant fine and very fine roots matted on silica-cemented lenses; many very fine and fine interstitial pores, and few fine and very fine tubular pores; violent effervescence; pH 8.5; clear, wavy boundary.

IIIC2si—22 to 44 inches, light-gray (10YR 7/2) very gravelly coarse sand (60 percent gravel), brown (10YR 5/3) when moist; contains a few ½- to 4-inch massive lenses where silica has weakly cemented the material; lenses are very hard when dry and firm when moist; single grain; loose when dry or moist; plentiful fine and very fine roots; many fine and very fine, and few medium interstitial pores; strong effervescence; pH 8.5; abrupt, wavy boundary.

IIIC3sica—44 to 50 inches, white (10YR 8/1) very gravelly coarse sand (60 percent gravel), light gray (10YR 7/2) when moist; massive; weakly cemented with silica; very hard when dry, firm when moist, nonsticky and nonplastic when wet; few fine and very fine roots; few fine and very fine tubular pores, and few fine and very fine interstitial pores; violent effervescence; pH 8.5; clear, wavy boundary.

IIIC4—50 to 60 inches, light brownish-gray (10YR 6/2) very gravelly coarse sand (60 percent gravel), grayish brown (10YR 5/2) when moist; single grain; loose when dry or moist; few fine and very fine roots; many fine and very fine, and few medium interstitial pores; slight effervescence; pH 8.3; clear, wavy boundary.

IIIC5sicam—60 to 64 inches, white (10YR 8/2), strongly silica- and lime-cemented hardpan (60 percent gravel), light gray (10YR 7/2) when moist; massive; practically no roots; many micro and very fine interstitial pores; violent effervescence; pH 8.5.

Pebbles form a weak or moderate gravel pavement on the surface. The A1 horizon has a strongly developed vesicular porosity and is platy in structure or is structureless (massive). In a few places the A1 and B1t horizons are stony and have a stone content of about 10 percent. The B21t and B22t horizons are sandy clay, light clay, or heavy sandy clay loam, and in some places their gravel content is 5 to 35 percent. Segregated lime is common in the lower part of the B horizon. The depth to the C horizon ranges from 15 to 30 inches. Normally, from 40 to 75 percent of this horizon is gravel. The upper part of the C horizon contains few to common, very thin or thin (less than ½ inch thick) lenses in which the material is cemented with silica. These lenses are randomly oriented and are discontinuous. They do not stop the growth of roots. In addition, there are continuous strata weakly to strongly cemented with silica below a depth of 24 inches. The reaction ranges from moderately alkaline to very strongly alkaline. Generally, the alkalinity is strongest in the lower B horizon or the upper C horizon.

The Tickapoo soils are well drained. Runoff is very slow on the nearly level slopes and is medium on the strong slopes. The soils have slow permeability, low available water capacity, moderate natural fertility, and a deep root zone. Erosion is a slight to severe hazard.

These soils are used for limited livestock grazing and as habitat for upland wildlife. Most areas are suitable for cultivation and for irrigation if water is made available.

Tickapoo gravelly fine sandy loam, 0 to 2 percent slopes (TcA).—This soil is in a relatively small area along the southern boundary of the Penoyer Area. It lies on the nearly level lower part of an alluvial fan, where the average slope is about 1 percent and runoff is very slow. The A horizon of this soil is 2 to 4 inches of gravelly fine sandy loam that has a gravel content of 15 to 35 percent. Beginning at a depth of 30 to 40 inches is very gravelly, sandy material in which silica cementation is lacking. This material is loose when dry or moist. Galleta, bud sagebrush, winterfat, Mormon-tea, and shadscale make up the plant cover.

Small nongravelly areas are included with this soil. Also included are small areas in which the soil has a stratified C horizon that is weakly and strongly cemented with silica. These inclusions occupy about 15 percent of the total acreage.

This soil is used to a limited extent for range, and it provides habitat for upland wildlife. It can be prepared and used for irrigated crops if water is made available. On range managed for cattle, the most important plants are Indian ricegrass, winterfat, and galleta. (Capability unit IIIs-3, irrigated; VIIs-4, dryland)

Tickapoo gravelly sandy loam, 2 to 4 percent slopes (TdB).—This soil occurs on gently sloping alluvial fans in the northern and west-central parts of Penoyer Valley. Its surface, though generally smooth, is cut by many drainage channels. These channels are no longer eroding. Most of them are 1 to 2 feet deep, but a few are 2 to 10 feet deep. The soil has a profile similar to the one described for the series, except that it contains gravel in

the A and B horizons. Here, the gravel content ranges from 20 to 30 percent. Surface runoff is very slow. The vegetation is mainly galleta, bud sagebrush, winterfat, and shadscale.

Included with this soil are nongravelly areas and eroded spots. Also included, in the deeper drainage channels, are small areas of gravelly Leo soils and Fang soils. These inclusions account for about 20 percent of the total acreage.

This soil is used for limited livestock grazing and as habitat for upland wildlife. It can be developed as irrigated cropland if water is made available. Indian ricegrass, winterfat, and galleta are the most important plants on range managed for cattle. (Capability unit IIIe-3, irrigated; VIIs-4, dryland)

Tickapoo gravelly sandy loam, 2 to 4 percent slopes, eroded (TdB2).—This soil is on smooth, gently sloping alluvial fans in the northwestern part of Penoyer Valley. Although the average slope is about 3 percent, the soil is cut by many drainage channels 1 to 4 feet deep. During high-intensity rainstorms, these channels are washed by concentrated runoff from higher lying soils. Except for the gravel in its A and B horizons, this soil has a profile similar to the one described for the Tickapoo series. In these horizons the gravel content ranges from 15 to 30 percent. Runoff is slow. The vegetation consists of galleta, spiny hopsage, Anderson wolfberry, littleleaf horsebrush, and Mormon-tea.

Included with this soil are a few scattered stony spots, as well as several fairly large areas that are not eroded. Also included, in the drainage channels, are areas of very gravelly Leo soils. The inclusions make up about 15 percent of the total acreage.

This soil is in range that is used for limited grazing by livestock. It also provides habitat for upland wildlife. The soil can be prepared for irrigation and cropped if water is made available, but structures are needed to control erosion in the drainage channels. On range managed for cattle, the most important plants are Indian ricegrass, desert needlegrass, and galleta. (Capability unit IIIe-3, irrigated; VIIs-4, dryland)

Tickapoo sandy loam, 2 to 4 percent slopes (TkB).—This soil occupies smooth, gently sloping alluvial fans in the southwestern part of Penoyer Valley. The average slope is slightly more than 2 percent, but the surface is broken by a few drainage channels 1 to 4 feet deep. Surface runoff is very slow. Galleta, spiny hopsage, Anderson wolfberry, littleleaf horsebrush, and bud sagebrush make up the plant cover.

Included with this soil are small areas in which the soil is fine sandy loam or loam to a depth of 2 to 3 inches; gravelly areas where 15 to 25 percent of the soil mass is gravel; and some eroded spots. These inclusions cover about 5 percent of the total acreage.

This soil is used for limited grazing by livestock and as habitat for upland wildlife. On range managed for cattle, the most important plants are Indian ricegrass, desert needlegrass, and galleta. The soil is suitable for use as irrigated cropland if water is made available. If the soil is irrigated, care must be taken to avoid a perched water table above the slowly permeable C horizon that could injure deep-rooted crops. (Capability unit IIIe-3, irrigated; VIIs-4, dryland)

Tickapoo-Leo association, 4 to 12 percent slopes (TlC).—This mapping unit occurs on moderately sloping and strongly sloping alluvial fans below the mountains in the northwestern part of the Penoyer Area. The vegetation consists of galleta, shadscale, bud sagebrush, littleleaf horsebrush, and Mormon-tea.

About 60 percent of the association is Tickapoo gravelly sandy loam, 4 to 12 percent slopes; 20 percent is Leo gravelly sandy loam, 4 to 12 percent slopes; and 20 percent is included areas of other soils.

Tickapoo gravelly sandy loam, a soil that occupies the higher parts of the fans, contains silica-cemented strata in the C horizon. It is gravelly in the uppermost 2 to 4 inches and has slow or medium runoff, depending on slope, but otherwise it is similar to the soil described in the representative profile.

Leo gravelly sandy loam occurs in many narrow drainage channels and in areas of deposition where the channels converge. It has a profile similar to the one described on page 31. Surface runoff is slow.

The inclusions are mainly spots of stony and cobbly Tickapoo soils and Leo soils at the higher elevations on the fans. In addition, there are included areas of eroded Tickapoo soils.

The soils in this association are used as range that furnishes limited grazing for livestock. On range that is managed for cattle, the most important plants are Indian ricegrass, winterfat, desert needlegrass, and galleta. The soils lie in areas that are too small and too strongly sloping for cultivation or for irrigation. (Capability unit VIIs-4, dryland)

Timpahute Series

The Timpahute series consists of fine-textured soils that are underlain by a hardpan cemented with silica and lime. These soils developed in alluvium derived from ignimbrite. They are on old, dissected, gently sloping to strongly sloping alluvial fans in Penoyer Valley.

Representative profile of a Timpahute soil, located about 550 feet east of the center of section 28, T. 1 N., R. 55 E.:

A1—0 to 3 inches, light-gray (10YR 7/2) very stony clay loam, dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure; slightly hard when dry, very friable when moist, sticky and plastic when wet; few fine roots; many fine and medium vesicular pores; noneffervescent; pH 8.4; abrupt, smooth boundary.

B21t—3 to 5½ inches, brown (7.5YR 5/4) light clay, dark brown (7.5YR 4/4) when moist; moderate, medium and fine, prismatic structure that breaks to strong, fine and very fine, subangular blocky structure; slightly hard when dry, very friable when moist, sticky and plastic when wet; plentiful very fine and fine roots; many very fine and fine interstitial pores, and few fine tubular pores; thin continuous clay films on ped faces and in pores; no effervescence; pH 8.6; abrupt, smooth boundary.

B22tca—5½ to 13 inches, brown (7.5YR 5/4) light clay, dark brown (7.5YR 4/4) when moist; moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; abundant very fine and fine roots, and few medium roots; common very fine and fine tubular pores; many thin clay films on ped faces and in pores; strongly effervescent; common, medium and coarse, distinct mottles of white lime; pH 8.6; clear, wavy boundary.

B23tca—13 to 18 inches, brown (7.5YR 5/4) gravelly clay loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; plentiful very fine and fine roots; many very fine interstitial pores, and few very fine and fine tubular pores; few thin clay films on ped faces, and few thin clay bridges between sand grains; violently effervescent; many, medium and coarse, distinct mottles of white lime; pH 8.6; clear, wavy boundary.

B3tca—18 to 27 inches, brown (10YR 5/3) gravelly sandy clay loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; plentiful very fine and fine roots; many very fine and fine interstitial pores, and common very fine and fine tubular pores; few thin clay bridges between sand grains; violently effervescent; many, medium and coarse, distinct mottles and coatings of lime on all gravel; pH 8.5; abrupt, smooth boundary.

C1sicam—27 to 33 inches, white (10YR 8/1), indurated, gravelly, silica-lime cemented hardpan, light brownish gray (10YR 6/2) when moist; massive; very few, very fine roots oriented horizontally; common micro interstitial pores; pan has a troweled surface and contains many continuous laminar bands; violently effervescent, but does not break down completely in acid; pH 8.5; abrupt, wavy boundary.

IIC2—33 to 40 inches +, light brownish-gray (10YR 6/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; no roots observed; many very fine and fine interstitial pores; effervescent; pH 8.5.

The surface is covered by an almost continuous stone pavement. The A1 horizon has strongly developed porosity and is leached. Segregated lime occurs above the hardpan (C1sicam horizon). The hardpan ranges from 19 to 29 inches in depth and from 5 to 12 inches in thickness. In some places the hardpan is continuously indurated, and in others it consists of indurated lenses 1½ to 3 inches thick that are interbedded with noncemented material. These lenses are gravelly loamy sand in texture, and they are hard or very hard when dry but are friable or firm when moist. The IIC2 horizon is structureless (either massive or single grain). It is slightly hard to loose when dry and very friable or loose when moist. The reaction in the profile is moderately alkaline to strongly alkaline.

These well-drained soils have medium runoff, are very slowly permeable, and have low available water capacity. Their inherent fertility is moderate, and their root zone is moderately deep. The erosion hazard is only slight because the surface is covered with gravel.

The Timpahute soils are in range that provides limited grazing for livestock. They are not suitable for cultivation or for irrigation.

Timpahute very stony clay loam, 2 to 12 percent slopes (TmC).—This soil occupies gently sloping to strongly sloping alluvial fans in the northwestern part of Penoyer Valley. The fans are cut by several drainage channels 1 to 4 feet deep and by several channels of intermittent streams, 4 to 10 feet deep. The vegetation consists of spiny hopsage, bud sagebrush, galleta, littleleaf horsebrush, and Mormon-tea.

Included with this soil are tracts of Leo soils, which lie in deep, narrow drainage channels and in areas where the channels converge. These inclusions make up about 8 percent of the total acreage.

This soil is in range that is grazed by livestock. It is too rough and too stony for cultivation or for irrigation. On range managed for cattle, the most important plants are Indian ricegrass, desert needlegrass, and galleta. (Capability unit VIIs-7, dryland)

Timpahute-Leo association, 2 to 12 percent slopes (TnC).—This mapping unit occurs on gently sloping to strongly sloping alluvial fans in the northwestern part of Penoyer Valley. The fans are convex and are dissected by many narrow drainage channels 5 to 12 feet deep. The vegetation consists chiefly of spiny hopsage, bud sagebrush, galleta, and Mormon-tea.

About 70 percent of the association is Timpahute very stony clay loam, 2 to 12 percent slopes; 20 percent is Leo gravelly sandy loam, 2 to 12 percent slopes; and 10 percent is inclusions, mainly stony areas of Timpahute clay loam, very gravelly and cobbly areas of Leo soils, and very steep breaks adjacent to drainageways.

Timpahute very stony clay loam occupies areas on alluvial fans and contains an indurated hardpan. Leo gravelly sandy loam, a very deep soil, occurs in numerous drainage channels and in areas of deposition where the channels converge. A detailed description of the Leo soil is given on page 30.

The soils in this association are used as range that furnished limited grazing for livestock. On range managed for cattle, the most important plants are Indian ricegrass, desert needlegrass, and galleta. (Timpahute soil: capability unit VIIs-7, dryland; Leo soil: capability unit VIIs-4, dryland)

Timper Series

In the Timper series are moderately coarse textured soils that contain a hardpan strongly cemented with silica and lime. These soils, which are slightly affected by salts and alkali, developed in alluvium derived mainly from tuff but partly from andesite, basalt, quartzite, and limestone. They are on nearly level, old flood plains and low-lying terraces in Penoyer Valley.

Representative profile of a Timper soil, located about 1,320 feet south and 820 feet west of the northeast corner of section 33, T. 3 S., R. 55 E.:

A1—0 to 3 inches, gray (10YR 6/1) sandy loam (10 percent fine gravel), dark grayish brown (10YR 4/2) when moist; weak, medium, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine roots; many fine and medium vesicular pores; strongly effervescent; pH 8.7; abrupt, smooth boundary.

C1—3 to 6 inches, light-gray (10YR 7/2) sandy loam, dark brown (10YR 4/3) when moist; weak, thick, platy structure; soft when dry, very friable when moist, very slightly sticky and very slightly plastic when wet; few fine roots; few fine tubular pores, and many fine vesicular pores; strongly effervescent; pH 8.7; clear, smooth boundary.

C2—6 to 10 inches, light brownish-gray (10YR 6/2) sandy loam, dark brown (10YR 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant fine roots; many very fine and fine interstitial pores; violently effervescent; pH 8.8; clear, wavy boundary.

C3sicam—10 to 18 inches, white (10YR 8/2), strongly silica-lime cemented, gravelly hardpan, grayish brown (10YR 5/2) when moist; moderate, thick, platy

structure; abundant fine roots in cracks and between plates; many micro pores and many cracks that occur between plates and where the pan is fractured; violently effervescent; pH 8.8; clear, wavy boundary.

IIC4sica—18 to 27 inches, light-gray (10YR 7/1) strata of gravelly loamy sand and sand, grayish brown (10YR 5/2) when moist; moderate, thick, platy structure because of stratification and weak cementation, single grain in other strata; hard in some strata and loose in others when dry, firm and loose when moist, nonsticky and nonplastic when wet; plentiful fine roots that run horizontally between plates; common micro interstitial pores in cemented strata, and many very fine and fine interstitial pores in other strata; violently effervescent on the outer faces of plates and slightly effervescent within plates and noncemented strata; pH 8.9; clear, wavy boundary.

IIC5sicam—27 to 36 inches, light-gray (10YR 7/1) strongly silica-lime cemented hardpan (10 percent gravel), grayish brown (10YR 5/2) when moist; weak, thick, platy structure; very few fine roots; few fine tubular pores; slightly effervescent in fractures and noneffervescent elsewhere but has thin, white (10YR 8/2) when dry, very pale brown (10YR 7/3) sheets where lime has accumulated on plate tops; pH 9.0; abrupt, wavy boundary.

IIC6—36 to 60 inches +, light-gray (10YR 7/2) very gravelly loamy coarse sand, dark brown (10YR 4/3) when moist; single grain; loose when dry or moist; very few fine roots; very porous; noneffervescent; pH 8.1.

In some places the A1, C1, and C2 horizons are fine sandy loam. In places these horizons contain gravel, which generally makes up less than 25 percent of the volume but may account for as much as 40 percent. The depth to the hardpan (C3sicam horizon) ranges from 10 to 20 inches. The hardpan may include several strata that are weakly or strongly cemented, and it may be stratified with materials that are not cemented. The depth to loose material (IIC6 horizon) ranges from 30 to 40 inches. The reaction ranges from mildly alkaline to very strongly alkaline. Normally, the alkalinity increases with depth to the pan and decreases sharply below it.

The Timper soils are now well drained, but the profile suggests that drainage was not so good while the soils were developing. They have medium or slow runoff, very slow permeability, and a shallow root zone. Natural fertility and the available water capacity are very low. Erosion is a slight hazard.

Timper sandy loam (Tp).—This soil occupies a smooth, low, nearly level terrace north of Shadow Well in Penoyer Valley. The vegetation is mainly graymolly and shadscale, but there are some annual plants.

Included in areas mapped as this soil are intermingled small areas of Papoose soils. Unlike the Timper soil, the Papoose soils lack a hardpan. Also included, along broad but shallow drainage channels, are small areas of Fang soils, which also lack a hardpan. Then too, there are included areas where wind has formed small hummocks of sandy material, 4 to 5 inches high, at the base of shrubs. These inclusions make up about 10 percent of the total acreage.

This soil is used for limited livestock grazing. It is not suitable for cultivation or for irrigation, because it is shallow and has very low available water capacity. On range managed for cattle, the most valuable plants are graymolly and shadscale. (Capability unit VIIs-8, dryland)

Tippipah Series

The Tippipah series consists of soils that have a gravelly or very gravelly, coarse-textured substratum and are slightly affected by salts and alkali. These soils developed in alluvium derived principally from basalt and ignimbrite. They occupy smooth, nearly level alluvial fans in Penoyer Valley.

Representative profile of a Tippipah soil, located about 400 feet east and 300 feet south of the northwest corner of section 31, T. 3 S., R. 55 E.:

A1—0 to 4 inches, light-gray (10YR 7/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure; soft when dry (but surface 1/8 to 1/4 inch is slightly hard), very friable when moist, nonsticky and nonplastic when wet; few very fine roots; many medium and fine vesicular pores; no effervescence; pH 8.5; abrupt, wavy boundary.

A&B—4 to 8 inches, pale-brown (10YR 6/3) loam with a sprinkling of light-gray (10YR 7/2) bleached sand and silt particles, dark brown (10YR 4/3) when moist; very weak, medium, columnar structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine and very fine roots; many very fine and fine vesicular pores in the topmost 1 inch, below which are common very fine and fine interstitial pores; few thin patchy clay films on ped faces and in pores; no effervescence; pH 8.5; abrupt, slightly wavy boundary.

B21t—8 to 18 inches, light-brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) when moist; strong, medium, columnar structure; hard to very hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few medium roots, and plentiful very fine and fine roots; many very fine vesicular pores in the upper part and common very fine interstitial pores in the lower part; many thin and few moderately thick clay films on ped faces; generally no effervescence, but strong effervescence where few, fine and medium, faint filaments of white (10YR 8/2) lime occur; pH 8.6; clear, wavy boundary.

B22tca—18 to 24 inches, light-brown (7.5YR 6/4) gravelly sandy clay loam (25 percent gravel), brown (7.5YR 5/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few very fine and fine roots; many very fine interstitial pores, and few fine tubular pores; common thin clay films on ped faces and in pores; generally no effervescence, but strong effervescence where a few, medium, distinct filaments of white (10YR 8/2) lime occur and where lime coats the under side of pebbles; pH 8.6; clear, wavy boundary.

B3tca—24 to 28 inches, light-brown (7.5YR 6/4) gravelly loamy coarse sand (35 to 40 percent gravel), brown 7.5YR 5/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful very fine and fine roots; many very fine interstitial pores; few fine clay films between sand grains; generally no effervescence, but strong effervescence where few, medium, distinct filaments of white (10YR 8/2) lime occur and where lime forms a thin film on pebbles; pH 8.2; clear, wavy boundary.

C1sica—28 to 44 inches, very pale brown (10YR 7/3) gravelly loamy coarse sand (45 percent gravel), dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine roots; many very fine and fine interstitial pores; contains few, discontinuous, very thin (less than one-eighth inch thick) strata strongly cemented with silica; violent effervescence; moderately thick lime crust on under sides of pebbles and a small amount of segregated lime throughout this material; pH 8.2; abrupt, wavy boundary.

IIC2—44 to 49 inches, white (10YR 8/2) very gravelly loamy coarse sand (65 percent gravel), grayish brown (10YR 5/2) when moist; massive; hard when dry, friable when moist, nonsticky and nonplastic when wet; few very fine roots; many very fine and fine interstitial pores; strong effervescence; pH 8.6; abrupt, wavy boundary.

IIC3sica—49 to 55 inches, light-gray (10YR 7/2) very gravelly coarse sand (75 percent gravel), grayish brown (10YR 5/2) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few very fine roots; many very fine and fine interstitial pores; violent effervescence where few thin silica-lime cemented strata occur, slight effervescence elsewhere; pH 8.7; abrupt, wavy boundary.

IIC4—55 to 65 inches +, light brownish-gray (10YR 6/2) very gravelly coarse sand (75 percent gravel), dark grayish brown (10YR 4/2) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; devoid of roots; many very fine and fine interstitial pores; no effervescence; pH 8.5.

The A1 horizon is moderately vesicular. The A&B horizon has columnar or prismatic structure that breaks readily to platy structure. In the upper part of the B horizon, the texture is sandy clay loam or clay loam in which the gravel content is 0 to 25 percent. The exchangeable sodium percentage in the B horizon ranges from 15 to 40 percent. The depth to the C horizon ranges from 24 to 30 inches. In most places just below the B horizon, or within a depth of 40 inches, there are discontinuous strata very weakly or weakly cemented with silica. These strata are hard to extremely hard when dry and are firm to extremely firm when moist. In addition, they are randomly oriented but are mostly diagonal. The gravel content in the C horizon ranges from 45 to 85 percent. Throughout the profile the reaction ranges from moderately alkaline to very strongly alkaline.

These well-drained soils have very slow runoff and moderately slow permeability. Their natural fertility and available water capacity are moderate, and their root zone is very deep. The hazard of erosion is moderate.

Tippipah sandy loam (Tr).—This soil lies on a nearly level alluvial fan, where the average slope is about 1 percent, south of State Route 25 in Penoyer Valley. It is slightly affected by salts and alkali. Shadscale, bud sagebrush, winterfat, and galleta are the principal plants.

Included with this soil are a few sandy hummocks and ridges, none of which is more than 8 inches high, and some small gravelly areas. These inclusions occupy about 5 percent of the total acreage.

This soil is used for range that is grazed by livestock, and it provides habitat for upland wildlife. On range managed for cattle, the most important plants are desert needlegrass and galleta. The soil can be developed as irrigated cropland if water is made available. The slight concentration of salts and alkali could be reduced through proper irrigation, though a heavy application of water would be needed periodically to maintain a favorable salt balance. (Capability unit IIIs-3, irrigated; VIIs-4, dryland)

Tolicha Series

The Tolicha series consists of stony, moderately coarse textured soils that formed in material weathered in place from basaltic bedrock. These soils are on moderately sloping to strongly sloping hills and on rolling foothills in the Penoyer Valley.

Representative profile of a Tolicha soil, located about 350 feet east and 1,050 feet south of the northwest corner of section 35, T. 2 S., R. 54 E.:

A1—0 to 3 inches, light-gray (10YR 7/2) extremely stony very fine sandy loam (50 percent stones and gravel), dark grayish brown (10YR 4/2) when moist; weak, thick, platy structure; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; no plant roots observed; common medium, and many very fine and fine vesicular pores; violently effervescent; pH 8.5; abrupt, smooth boundary.

C1—3 to 7 inches, light-gray (10YR 7/2) stony loam (30 to 40 percent stones and gravel), brown (10YR 5/3) when moist; massive (structureless) to weak, medium and fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; many very fine vesicular pores, and many fine and very fine interstitial pores; violently effervescent; pH 8.7; clear, wavy boundary.

C2—7 to 12 inches, very pale brown (10YR 7/3) stony and gravelly fine sandy loam (30 to 40 percent stones and gravel), brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist, nonsticky and slightly plastic when wet; few, medium and abundant, very fine and fine roots; many micro and very fine interstitial and tubular pores; violently effervescent; pH 8.9; abrupt, irregular boundary.

R—12 to 14 inches +, slightly weathered, hard basaltic bedrock that has thin, white lime and silica coatings on surface and in cracks and crevices.

Covering the surface are flat, angular and subangular pebbles, ⅛ to 2 inches in diameter, that form an almost continuous gravel pavement. The pebbles have a burnished, dark-brown desert varnish of iron and manganese oxides on exposed surfaces. In the uppermost 2 to 4 inches of the profile, there is a strongly developed vesicular porosity. The coarse fragments in the profile vary considerably in number and size from place to place. Their content ranges from 50 to 80 percent in the A1 horizon and from 35 to 50 percent in the C horizon. Normally, most of the fragments are stones. The depth to bedrock ranges from 10 to 20 inches. The reaction ranges from moderately alkaline to very strongly alkaline.

These soils are well drained. Runoff is medium, permeability is moderate, and the available water capacity is very low. The soils have low natural fertility and a very shallow or shallow root zone. Erosion is a moderate hazard.

Tolicha extremely stony very fine sandy loam, 4 to 12 percent slopes (TsD).—Most of this soil is on the moderately sloping or strongly sloping sides and top of Black Rock Hill near State Route 25 in Penoyer Valley. Dominant in the plant cover are spiny hopsage, fourwing saltbush, low Douglas rabbitbrush, Anderson wolfberry, and Mormon-tea. Also, there is some galleta.

Included in areas mapped as this soil are many outcrops of rock, generally less than 5 acres in size. Also included are areas of rubble, most commonly adjoining the outcrops on the lower side. These inclusions make up about 15 percent of the total acreage.

This soil is used to provide limited grazing for livestock. It is so stony, so strongly sloping, and so shallow that it is not suitable for cultivation and irrigation. On

range managed for cattle, the most important plants are desert needlegrass and galleta. (Capability unit VIIs-7, dryland)

Tufa Rock Land

This miscellaneous land type consists of tufa, a chemical sedimentary rock composed of calcium carbonate and silica. The rock formed as a deposit from springs, streams, or lakes. It occurs as a relatively large mound adjacent to the playa in Penoyer Valley and as several smaller mounds close to springs in Pahranagat Valley. These mounds are mainly in areas of Kawich and of Ash Springs soils.

Tufa rock land-Kawich association, 0 to 12 percent slopes (TuD).—This mapping unit consists of a large mound of tufa rock that rises about 50 feet above the Penoyer Valley floor, together with the more mildly sloping sandy soil that lies on the flanks of the mound. At the eastern edge of the mound is Sand Spring, which is the only surface source of water in the valley, though it did not contribute to formation of the tufa. The rock supports no vegetation, but the Kawich soil is in stands of greasewood, fourwing saltbush, shadscale, and seepweed.

About 40 percent of the association is Tufa rock land; 35 percent is Kawich fine sand, 0 to 12 percent slopes; and 25 percent is included small areas of a soil that is somewhat like Kawich fine sand but is less than 40 inches deep over tufa.

Kawich fine sand is a very deep soil that formed in windblown material accumulated around the outer edge of the tufa mound. This soil has a hummocky surface and is 40 to more than 60 inches deep over tufa. Its profile is similar to the one described on page 27.

The soil in this association is in range that provides limited grazing for livestock. Because it is highly susceptible to soil blowing and, in many places, is moderately sloping or strongly sloping, it is not suitable for cultivation or irrigation. On range managed for cattle, the most important plants are fourwing saltbush, Indian ricegrass, and shadscale. No use is made of Tufa rock land. (Tufa rock land: capabiilty unit VIIIs-7, dryland; Kawich soil: capability unit VIIs-L, dryland)

Woodrow Series

The Woodrow series consists of moderately fine textured soils that are strongly affected by salts and alkali. These soils developed in alluvium derived from various kinds of rocks. They lie in smooth, almost flat basins in Penoyer Valley.

Representative profile of a Woodrow soil, located 300 feet south and 160 feet west of the north quarter corner of section 31, T. 2 S., R. 56 E.:

A1—0 to 2 inches, white (10YR 8/2) light clay loam, grayish brown (10YR 5/2) when moist; moderate, medium, platy structure; slightly hard when dry, friable when moist, sticky and plastic when wet; few very fine roots; many very fine and fine, and common vesicular pores; violently effervescent; pH 9.0; abrupt, smooth boundary.

C1—2 to 6 inches, light-gray (10YR 7/2) light clay loam, dark brown (10YR 4/3) when moist; moderate, medium, platy structure; hard when dry, friable when moist, sticky and plastic when wet; few very fine and fine roots; many very fine and fine vesicular and tubular pores; violently effervescent; pH 9.0; clear, smooth boundary.

IIC2—6 to 13 inches, light-gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) when moist; moderate, medium, platy structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant very fine roots, few fine and medium roots; many very fine and fine tubular pores; violently effervescent; pH 9.0; clear, smooth boundary.

IIIC3—13 to 18 inches, silty clay loam similar to IIC2 horizon in color; strong, medium, platy structure; hard when dry, friable when moist, sticky and plastic when wet; few very fine and fine roots; many very fine and fine tubular and vesicular pores; violently effervescent; pH 9.0; clear, smooth boundary.

IIIC4—18 to 28 inches, heavy silt loam similar to IIC2 horizon in color; strong, thin, platy structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; plentiful very fine and fine roots; many very fine vesicular pores; violently effervescent; pH 9.0; clear, smooth boundary.

IIIC5—28 to 70 inches +, brown (10YR 5/3) light silty clay loam, dark brown (10YR 4/3) when moist; moderate, medium, platy structure; hard when dry, firm when moist, sticky and plastic when wet; few very fine and fine roots; few very fine and fine tubular pores; violently effervescent; pH 9.0.

In some places a thin crust of salt covers the surface. The texture in the profile is dominantly silty clay loam or heavy silt loam, but in places there are thin strata of fine sandy loam, very fine sandy loam, or loam. The reaction is strongly alkaline or very strongly alkaline. In some places the alkalinity is uniform throughout the profile; in others it decreases with depth.

These soils are well drained, and they have very slow runoff and high available water capacity. Permeability is slow in undisturbed areas because of the platy structure, but it would be moderately slow if the soil were cultivated. Natural fertility is high, and the root zone is very deep. The hazard of erosion is slight.

Woodrow clay loam (Wc).—This soil occupies a relatively small area on a smooth, nearly level flood plain northeast of Sand Spring in Penoyer Valley. It is strongly affected by salts and alkali, and about 1 year in 10, it is covered by water running off higher lying soils. The vegetation consists of greasewood, fourwing saltbush, seepweed, shadscale, and graymolly.

Included with this soil are spots of Woodrow soils that are moderately affected by salts and alkali. Also included are small areas of Kawich fine sand, which occurs in low dunes or ridges. These inclusions make up about 15 percent of the total acreage.

This soil is in range that provides limited grazing for livestock and habitat for upland wildlife. On range managed for cattle, the most important plants are graymolly and fourwing saltbush. The soil can be made suitable for irrigation if water becomes available. (Capability unit IIs-6, irrigated; VIIs-6, dryland)

Use and Management of Soils

In this section are discussed general management practices, water supply, drainage, salts and alkali, molybdenum toxicity, capability groups of soils, estimated yields, managing soils for wildlife, and the engineering uses of soils.

General Management Practices

Although each soil in the Pahranagat-Penoyer Areas differs somewhat from the others, certain practices of management apply to all of the soils that are cultivated. Among these practices are use of suitable crop rotations, adding plant nutrients in fertilizer and manure, and controlling erosion. At the present time, the only soils cultivated are in the Pahranagat Area.

Crop rotations

The crop rotation most commonly used in the Pahranagat Area consists of 2 years of a row crop, 1 year of a small grain, and 4 years of a legume. Suitable row crops are potatoes, carrots, sugarbeets, corn for silage, and vegetables grown for seed. Barley is the principal small grain, but some rye, oats, and winter wheat also are grown. A small grain commonly serves as a companion crop for an alfalfa seeding.

Alfalfa is the most important legume. It should be seeded in mixture with grass, such as alta fescue or orchardgrass. This provides a better hay mixture, and the more extensive root system of the grass improves soil structure.

Addition of plant nutrients

Adding commercial fertilizer or manure is the usual means of correcting nutrient deficiencies. The soils in both Areas generally are deficient in nitrogen, and all crops, including newly seeded legumes, benefit from its addition. Available phosphorus is needed, especially on the strongly calcareous soils and at high levels of production. Potatoes respond to both nitrogen and phosphorus. Small amounts of nitrogen and little or no phosphorus are used on small grain. Very little fertilizer is used on established stands of alfalfa, but on the strongly calcareous soils this crop may respond to added phosphorus.

The potassium supply seems to be adequate in all the soils, though added amounts of potassium might be beneficial on coarse-textured soils that are heavily cropped. The soils in both Areas have no known deficiencies of sulfur, calcium, magnesium, copper, zinc, molybdenum, boron, or manganese. The supplies of these elements may be depleted in time, especially under heavy cropping on the coarse-textured soils.

In the Pahranagat Valley, some soils having a high water table contain molybdenum in amounts that are toxic to livestock. Whether the amount of molybdenum in a soil is excessive depends on the degree of wetness, the content of organic matter, and the kind of parent material. The toxicity is readily corrected by injecting copper compounds in the animals.

Lime is so abundant in all the soils that it causes deficiencies of phosphorus and iron. A phosphorus deficiency slows the growth and reduces the yield of most crops, particularly alfalfa. Only the most water-soluble forms of phosphorus should be used, because the soils in both Areas are alkaline.

Yellowing in the leaves of trees, shrubs, and crops is a symptom of chlorosis, or iron deficiency, in the Areas. Chlorosis can be corrected by applying iron chelates, ferric sulfate, or glass frits containing iron.

Calcium sulfate (gypsum) is used in the Areas mainly to loosen fine-textured soils and to reclaim soils affected by alkali. In fields where gypsum is needed, the quality of the irrigation water should be checked, for a few wells supply water that contains a considerable amount of gypsum.

Erosion control

On most irrigated soils that are well managed, soil blowing is only a slight hazard. It can be controlled by plowing under crop residue, keeping the surface cloddy, and using subsurface tillage. On coarse-textured soils, stripcropping at right angles to the prevailing wind helps to control soil losses. Leaving stubble or crop residue on the surface also provides some protection.

Water erosion is generally only a slight hazard in cultivated areas, because only the most mildly sloping soils are used for crops.

Water Supply

The water used in the Pahranagat Valley comes mainly from underground sources. The greater amount is obtained from springs, which provide a total constant flow of about 80 acre-feet per day. The remaining water is supplied by wells of variable depth that are located chiefly in or near the channel of the ancient White River. None of the wells are free flowing, and the water pumped from these wells varies in temperature and quality. Most of the water for domestic use is obtained from shallow wells less than 50 feet deep.

In the Penoyer Valley, the total number of wells now in use is 17. Of this number, 14 were active at the time fieldwork for this soil survey was started, and three have been drilled since the work was completed. Of the older 14 wells, only two are located in the northern half of the Penoyer survey area. Most of the older wells are of small diameter and are used to furnish water for livestock. The other four wells are of larger diameter and were originally used during road construction and by mining enterprises.

The three newer wells in Penoyer Valley were drilled to obtain water for irrigation. These wells are south of State Route 25. While drilling was underway, the only materials encountered, to a depth of 160 feet, were coarse sand, gravel, and boulders. Hydraulic conditions are good. The pumping lift is about 100 feet, and the total capacity is more than 1,000 gallons per minute. These wells indicate that using at least some of the valley for irrigated crops is feasible.

Penoyer Valley is drained into a playa, a flat basin on the valley floor. Underground water flows toward the playa, as shown in this area by an abundance of greasewood (*Sarcobatus vermiculatus*), a shrub that indicates a high water table. In the area of the valley floor, the water table is within 20 feet of the surface. Here, along an imaginary line extending northeast and southwest, there is a series of small tufa domes and exposed travertine and sinters, all of which are rocks or deposits formed by the evaporation of spring water. The largest of these deposits is at Sand Spring and covers more than 350 acres. Along the northeast-southwest line, the presence of inland saltgrass (*Distichlis stricta*) in areas as much as 50 feet higher than the playa surface is evidence that ground water rises as it approaches the playa.

The State of Nevada engineer has tentatively estimated that the annual recharge of ground water in the Penoyer Valley is about 3,000 acre-feet. This estimate can be adjusted, if necessary, as more information becomes available.

Quality of irrigation water

The quality of water used for irrigation has a great effect on the soil, on the suitability and yield of crops, and on the amount of water in the soil actually available to plants. Table 2 gives data obtained by analyses of water sampled at selected springs, lakes, and wells in the Pahranagat and Penoyer Valleys.

Residual sodium carbonate, given in equivalents per million in table 2, was calculated by subtracting the sum of Ca and Mg from the sum of HCO_3 and CO_3.

In both valleys the water obtained from springs is similar and is of good quality (*5*). The water from wells in Pahranagat Valley generally can be safely used for irrigating crops, though it varies in quality, is highly saline, has a content of residual carbonate that is marginal for safe use, and contains boron that is occasionally toxic. In the Penoyer Valley, the well water is only about a third as salty as that in the Pahranagat Valley, but in other respects the water from wells in both valleys is similar.

The data shown in table 2 for wells and springs in Pahranagat Valley do not represent an accurate evaluation of all the water used for irrigation in the valley. The wells listed in the table provide water only for domestic use. These wells are shallow, and the water pumped from them likely is not representative of the ground water at greater depths. Because meadows are kept wet and many unlined ditches are used upstream, salts are progressively concentrated in the downstream part of the valley. In addition, some of the lakes are used as reservoirs for storing irrigation water. The stored water increases in salinity as some of it evaporates.

An example of the many ways in which water can vary in quality, as well as the ways in which soils can be affected by water, occurs in the Pahranagat Valley. On the flood plain between Hiko Spring and Maynard Lake —a distance of about 30 miles—the soils have been wet for many years because of meandering water, principally from three thermal springs. Although the three springs are fairly close together, the area affected by each one is largely separated from the other two.

In the area affected by each spring, the quality of the water varies greatly from the upstream part of the area to the downstream part. In the water downstream, there is a progressive increase in the total salt content, percentage of sodium, total content of sodium, pH value, and total content of carbonates, bicarbonates, boron, and fluoride. On the other hand, a decrease occurs in the percentage of carbonates and bicarbonates and in the percentage of calcium and magnesium.

These differences in water quality have differing effects on the soils. First, the salinity is highest in soils on the flood plain in the lower part of each area. Second, the lower half of each area contains soils in which the carbonates and bicarbonates of calcium and magnesium have been precipitated to enrich the lower part of the soil profile with carbonates. This explains why the sodium content in the water increases downstream.

In some places water of poor quality is suitable for irrigation if it is mixed with water of better quality. Also, water having a high content of sulfate is helpful in reclaiming alkali soils.

Drainage

The Penoyer Valley is a closed basin in which all drainage is toward a centrally located playa that is intermittently flooded. In the initial plan for irrigating soils in this valley, the first soils that will be brought under irrigation are the very deep, pervious Fang and Papoose soils. Unless the irrigated area is enlarged considerably by developing additional supplies of water, no serious drainage problem is expected.

The Pahranagat Valley is drained by the channel of the ancient White River, which flowed into the Colorado River. Presently, the water supply in the drainage basin of the old river is so low that little or no surface water moves through the valley. Surface water from seeps and springs is dissipated, mainly by evapotranspiration.

Although the flood plain in Pahranagat Valley is about 44 miles long, it is wetted by surface water only in the lower part. This part extends from Hiko Spring to Maynard Lake and is about 30 miles long. The flood plain is generally 1/4 to 1/2 mile wide, but in several places it has been narrowed by the encroachment of alluvial fans. At some of these narrows, there are small lakes that are used for storing the return flow of excess irrigation water, the winter flow from three large thermal springs, and the flow from many smaller springs in the valley.

Because drainage is restricted in the narrower parts of the flood plain, most of the soils on the flood plain have a high water table and are affected by salts and alkali. These adverse features are aggravated in soils located immediately upstream from the small lakes used as reservoirs.

Most of the irrigated soils in Pahranagat Valley are on the flood plain and, consequently, are wet to a varying degree. Of these wet soils, the most important and most extensive are the Adaven, Ash Springs, Bastian, and Pahranagat soils; the water table variants from the normal Lahontan soils; and some of the Geer and Seaman soils. On all of these soils, management is needed that maintains a favorable salt balance and keeps the water table at a level that is safe for crops.

Some areas on the flood plain have been partially drained by building drainage structures, both open and underground, and by lining the supply ditches. Channels have been constructed to provide an outlet for excess surface water through the narrows or into small lakes. Nevertheless, drainage in the valley generally is not satisfactory, for the water table is only fairly well controlled in a large acreage of wet soils, and an adequate outlet for excess water is still lacking in some areas.

A study of the drainage problem in Pahranagat Valley shows the need for an integrated plan of irrigation and drainage that is based on detailed engineering investigations. Such a plan should provide for lowering the water table, wherever feasible; disposing of excess surface and subsurface water throughout the valley; and supplying water of acceptable quality for use by crops and for leaching excessive salts from soils that can be made suitable for cultivation.

TABLE 2.—*Chemical analyses of water from selected springs,*

[Where no figure is given,

PAHRANAGAT

Source of water and location	Date of collection	Silica (SiO2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)
		EPM [2]	*EPM* [2]	*EPM* [2]	*EPM* [2]	*EPM* [2]
Springs:						
Hiko Spring, orifice (NW¼SW¼ sec. 14, T. 4 S., R. 60 E.).[4]	March 10, 1962	33	2. 20	1. 92	1. 26	0. 18
Crystal Spring (NW¼SW¼ sec. 10, T. 5 S., R. 60 E.).[5]	April 15, 1963	31	2. 25	1. 93	1. 00	. 13
Ash Springs (NW¼NW¼ sec. 6, T. 6 S., R. 61 E.)	June 4, 1944	----------	2. 32	1. 59	1. 30	----------
Lakes:						
Hiko Lake (SW¼SW¼ sec. 26, T. 4 S., R. 60 E.)	June 21, 1939	----------	4. 20	1. 88	10. 83	----------
Upper Pahranagat Lake (NE¼NE¼ sec. 4, T. 8 S., R. 61 E.).	September 14, 1944	----------	2. 13	5. 97	13. 00	----------
Lower Pahranagat Lake (SW¼NE¼ sec. 31, T. 8 S., R. 61 E.).	June 4, 1944	----------	1. 01	2. 21	20. 40	----------
Maynard Lake, outlet (SW¼SW¼ sec. 3, T. 9 S., R. 62 E.).	March 20, 1937	----------	2. 92	7. 76	16. 65	3. 29
Wells:						
Alamo town well (SW¼SE¼ sec. 5, T. 7 S., R. 61 E.)	September 22, 1944	----------	2. 80	1. 15	6. 35	----------
Farmstead well (SE¼SE¼ sec. 5, T. 7 S., R. 61 E.)	1942	----------	3. 65	2. 54	7. 70	----------
PENOYER						
Springs:						
Sand Spring (NW¼NW¼ sec. 26, T. 2 S., R. 55 E.)	May 8, 1961	----------	[6] 4. 83	----------	1. 45	0. 28
McCutchen Spring (SE¼SW¼ sec. 9, T. 1 N., R. 56 E.).[7]	May 8, 1961	----------	[6] 2. 61	----------	1. 63	. 13
Wells:						
Gunderson well (SE¼NW¼ sec. 32, T. 3 S., R. 55 E.)	May 8, 1961	----------	[6] 1. 31	----------	1. 65	. 18
Dodge well (SE¼SW¼ sec. 7, T. 3 S., R. 55 E.)	May 8, 1961	----------	[6] 1. 85	----------	2. 00	. 27
Sundown well (NW¼SE¼ sec. 8, T. 4 S., R. 55 E.)	May 8, 1961	----------	[6] 1. 75	----------	1. 83	. 20
Smith well (SW¼NE¼ sec. 26, T. 1 S., R. 54 E.)	May 8, 1961	----------	[6] 1. 51	----------	. 99	. 12

[1] Data for samples collected before 1960 are from "Irrigation Waters of Nevada" (*5*). All other data are unpublished. Analyses were made by DR. L. DUNN, chief, Soil and Water Testing Laboratory, University of Nevada Agricultural Experiment Station.

[2] Equivalent per million: A unit chemical equivalent weight of an ion per million unit weights of solution; equivalents per million and milliequivalents per liter are numerically identical if the specific gravity of the solution is 1.0.

[3] Parts per million.

[4] Temperature of the water 80° F. on date of collection. Total hardness calculated as $CaCO_3$ (actually calcium plus some magnesium) 206 parts per million.

Salts and Alkali

Most soils in arid and subarid regions contain at least small quantities of soluble salts, alkali, or both. Because rainfall is low and evaporation is high, percolating rainwater is insufficient for leaching all the salts out of the soil. Consequently, some of the salts remain in the root zone. In some soils the salts and alkali are highly concentrated and are toxic to plants.

In addition, many low-lying areas receive salty runoff or seepage. The shallow percolation and surface evaporation of such water generally results in a further increase of soluble salts on or in the soils. In some areas that have a high water table, water may rise in the soil by capillary action and bring dissolved salts with it. Soluble salts are readily dissolved in water and may move in solution to any part of the soil profile.

A soil that contains excessive amounts of soluble salts but not alkali is called a saline soil. One that contains excessive adsorbed sodium is called an alkali soil. A soil containing both excess soluble salts and alkali is described as saline-alkali (*10*).

Saline or saline-alkali phases of several of the soils have been mapped. In the Pahranagat-Penoyer Areas, four saline and alkali classes are defined. These classes are based primarily on the amount of salts or salts and alkali contained in the surface layer of the soil at the time of the survey. Three of the four classes are identified on the soil map as soil phases. The four classes are—

1. *Soils free of excess salts and alkali* contain less than 0.15 percent of salts. The conductivity of the saturation extract is less than 4 millimhos per centimeter at 25° C., and the percentage of exchangeable sodium is less than 12.
2. *Slightly saline-alkali soils* contain 0.15 to 0.35 percent of salts, or the conductivity of the saturation extract is 4 to 8 millimhos per centimeter at 25° C. The percentage of exchangeable sodium is 12 to 30 for coarse textured and moderately coarse textured soils and is 12 to 20 for medium-textured to fine-textured soils.

lakes, and wells in the Pahranagat and Penoyer Valleys [1]

information was not recorded]

Bicarbonate (HCO3)	Carbonate (CO3)	Sulfate (SO4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO3)	Boron (B)	Sodium-adsorption-ratio	Residual sodium carbonate	Specific conductance	Reaction
VALLEY										
EPM [2]	*EPM* [2]	*EPM* [2]	*EPM* [2]	*PPM* [3]	*EPM* [2]	*PPM* [3]		*EPM* [2]	*Micromhos per cm. at 25° C.*	*pH*
4. 26	0	0. 75	0. 31	0. 03	0. 02	0. 01	0. 88	0. 14	494	8. 0
4. 46	0	. 56	. 23	. 03	. 02	. 20	. 69	. 28	----------	8. 0
4. 20	0	. 72	. 30	----------	----------	. 37	. 65	. 29	480	----------
10. 00	0	5. 23	1. 69	----------	----------	----------	6. 23	3. 92	1, 824	----------
9. 80	1. 00	6. 98	3. 32	----------	----------	. 71	3. 24	1. 70	1, 775	----------
8. 95	2. 70	9. 01	3. 00	----------	----------	. 87	16. 06	5. 73	1, 751	----------
----------	9. 14	10. 84	4. 11	----------	----------	----------	7. 30	0	2, 655	----------
6. 80	. 57	2. 12	. 79	----------	----------	----------	4. 53	2. 85	1, 111	----------
8. 90	----------	3. 48	1. 60	----------	----------	. 98	4. 40	1. 71	1, 250	----------
VALLEY										
5. 18	0. 64	0. 17	0. 41	1. 40	----------	0. 12	----------	----------	640	8. 3
3. 45	0	. 62	. 63	. 70	----------	. 14	----------	----------	470	8. 0
1. 94	. 30	. 80	. 46	. 90	----------	. 10	----------	----------	350	8. 2
1. 87	. 54	1. 20	. 99	. 90	----------	. 12	----------	----------	460	8. 5
2. 07	. 66	. 76	. 41	1. 00	----------	. 10	----------	----------	390	8. 5
1. 84	. 34	. 32	. 40	. 40	----------	. 14	----------	----------	290	8. 5

[5] Temperature of the water 81° F. on date of collection. Total dissolved solids (residue at 180° C.) 277 parts per million. Total hardness calculated as $CaCO_3$ (actually calcium plus some magnesium) 223 parts per million.

[6] Total calcium and magnesium.

[7] McCutchen Spring is located a few miles north of the Penoyer survey area, but it is listed in this table so that the analysis of water from Sand Spring can be compared with that from another spring nearby.

3. *Moderately saline-alkali soils* contain 0.35 to 0.65 percent of salts, or the conductivity of the saturation extract is 8 to 15 millimhos per centimeter at 25° C. The percentage of exchangeable sodium is 30 to 40 for coarse textured and moderately coarse textured soils and is 20 to 30 for medium-textured to fine-textured soils.

4. *Strongly saline-alkali soils* contain more than 0.65 percent of salts, or the conductivity of the saturation extract is greater than 15 millimhos per centimeter at 25° C. The percentage of exchangeable sodium is greater than 40 for coarse textured and moderately coarse textured soils and is greater than 30 for medium-textured to fine-textured soils.

In the Penoyer Valley the strongest concentration of soluble salts and alkali is on the nearly level valley floor. In the soils of this valley, the salts are mostly in the surface layer and subsoil, whereas the alkali (adsorbed sodium) is at a slightly lower depth. The excess salts and alkali have been concentrated in the soils by the evaporation of saline water and by the action of plants, principally greasewood.

Saline-alkali soils on the floor of Penoyer Valley could be reclaimed, but most of them would not be suited to cultivated crops for other reasons. Among the better soils that could be reclaimed are those of the Penoyer series. Underlying the soils throughout the valley is porous material that would favor the leaching of soluble salts from the root zone.

In soils used for farming in the narrow Pahranagat Valley, the salt and alkali content is related to the quality of the water, the efficiency of irrigation, and the disposal of excess water. Generally, the salinity in these soils has changed little in the last 20 years. But on the Hiko Spring watershed and parts of the Ash Springs watershed, the total salt content in soils has been significantly lowered since 1938, when the irrigation ditches were lined with concrete. Lining the ditches reduced seepage losses of saline water used for irrigation. If

more ditches were lined, soil salinity could probably be lowered on a larger acreage. Extensive reclamation is unlikely, however, until a general plan is worked out for irrigating and draining the soils in Pahranagat Valley.

Leaching salts is difficult if a soil contains sodium, or alkali, that causes the clay particles to disperse in water and, as a result, reduces permeability. Whether a soil can be successfully leached is determined by the percentage of exchangeable sodium and also by texture. Dispersion is most likely to occur in fine-textured soils having a high percentage of exchangeable sodium. Applying gypsum reduces the alkali content and increases permeability, for the gypsum contains calcium that replaces the sodium. In soils that contain enough free lime, including all the saline-alkali soils in the Pahranagat-Penoyer Areas, sulfur also can be used for reducing the alkali content.

For any of several reasons, keeping the salt content low in the soils may not be desirable or economically feasible. Because of saline irrigation water, a high water table, slow permeability, or a need to use a field for crops while improvement is underway, some salinity is permissible if salt-tolerant crops are grown.

Molybdenum Toxicity

In addition to the mineral nutrients required by plants in large amounts, others are needed in only small amounts and are called the trace elements. They are iron, manganese, zinc, copper, boron, chlorine, and molybdenum. Although these elements are essential to growth, only enough is needed—and the difference between enough and too much is small. For example, plants may be harmed by a relatively small amount of molybdenum in the soil, and animals may be injured by eating the plants in which the molybdenum has accumulated.

In the Pahranagat Valley the soils known to produce forage that contains excess molybdenum are the Ash Springs soils, including the heavy subsoil variant, the Pahranagat soils, and the Lahontan soils, water table variant (*2, 4*). If cattle or sheep eat the forage produced on these soils, they are affected by molybdenum poisoning, or molybdenosis. Among the symptoms are anemia, diarrhea, loss of weight, stiffness, and fading of hair color. Even though the animals do not die, the poisoning causes a large economic loss. Younger animals are affected more severely than older ones. Observations indicate that molybdenum in pasture plants is more toxic than that in cured hay.

Recent work by Kubota (*4*) shows that molybdenum toxicity in the Pahranagat Valley is most likely on soils that have parent material derived from ignimbrite of rhyodacitic nature, impeded soil drainage, and a thick, dark-colored surface layer containing a large amount of organic matter. Poisoning is a hazard only on soils in which all three characteristics are present.

The Pahranagat soils, which formed in alluvium from ignimbrite, produce clover having a molybdenum content of 15 to 51 parts per million. Ignimbrite, however, is a general term for a kind of extrusive igneous rock that varies in content of trace elements from place to place. For this reason, excess molybdenum does not occur in all poorly drained soils derived from ignimbrite, such as the poorly drained variants from the normal Lahontan soils. Apparently, these Lahontan soils formed in alluvium that washed from other rocks as well as ignimbrite.

Impeded soil drainage contributes to a high concentration of molybdenum in forage. In contrast, the molybdenum content is low in forage plants grown on the well-drained Penoyer soils and the somewhat excessively drained Maynard Lake soils.

If drainage has been impeded for a long time, a result is an accumulation of organic matter in the surface layer. This also contributes to a high content of molybdenum in forage. The high molybdenum values reported by Kubota generally were from plants grown on such soils as the Pahranagat, in which drainage is poor or somewhat poor and the surface layer is thick and dark colored. As a rule, the dark color is good evidence of accumulated organic matter. An exception is the Ash Springs series, for the soils in this series contain enough lime in the surface layer to mask the dark color that would otherwise indicate the accumulation of organic matter.

If alfalfa and clover are grown together on the same soil, the alfalfa contains less molybdenum than the clover. Grasses, sedges, and rushes have a considerably lower molybdenum content than either clover or alfalfa grown on the same soil. The various species of clover, produced on the same soil, do not differ appreciably in the amount of molybdenum they contain. Among the species commonly grown in the Pahranagat Valley are alsike, red, White Dutch, strawberry, and Ladino clovers and sweetclover.

Spencer (*8*), in his studies of soil treatment to offset molybdenum toxicity, suggests the following:

1. Ammonium nitrate should not be applied as a fertilizer in areas where molybdenum poisoning is a hazard. This fertilizer causes an increase in the amount of molybdenum taken up by forage plants.
2. Copper should not be used on a soil in an attempt to overcome molybdenum toxicity. Not only does copper fail as a remedy, but it may increase the hazard by raising the molybdenum content in plants.

In the experimental treatment of cattle affected with molybdenum poisoning, Dye and O'Harra (*2*) successfully used injections of copper glycinate suspension. Under field conditions copper glycinate suspension can be injected rapidly and efficiently if a normal method is available for restraining the animals. Care should be taken to give a true subcutaneous injection of the material through the pendent skin of the dewlap in the region of the brisket.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to most horticultural crops, or to rice and other crops that have their own special requirements for economical production. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without considera-

tion of possible but unlikely major reclamation projects.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. Classes are defined as follows:

Class I. Soils have few limitations that restrict their use.

Class II. Soils have some limitations that reduce the choice of plants or require moderate conservation practices.

Class III. Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV. Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.

Class V. Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI. Soils have severe limitations that generally make them unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* shows that the chief limitation is climate that is too cold or too dry.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils.

In this survey, capability units are identified by numbers or letters that either indicate the chief limitation of the soils in the capability class and subclass or suggest other limitations, within the unit, in addition to the major limitation indicated by the subclass designation. The units in any given subclass may not be numbered consecutively, as the symbols are a key to some of the problems or limitations. The numbers and letters used to designate units are—

1. Slope.
2. Wetness.
3. Slow permeability.
4. Low available water capacity.
5. Clayey texture.
6. Excess salts or salts and alkali.
7. Stoniness or rockiness.
8. Depth limitation (over hardpan or bedrock).
9. Deficiencies or excesses of minerals.

F. Occasional overflow.
L. Coarse texture.
K. Rainfall insufficient for reseeding perennial grass.
P. Poor drainage.

Two or more numbers, or a number and a letter, are used if the soils have more than one kind of limitation. For example, in capability unit IIIs-14L are sloping soils (1), that have low available water capacity (4), and are coarse textured (L).

The classification of the soils placed in capability classes I through IV in the Pahranagat-Penoyer Areas represents what their uses and limitations are if irrigation water is available, but no attempt has been made to evaluate the economic feasibility of providing the necessary water. The classification of the soils in capability classes VI and VII is based on the degree and kind of limitation for use as range.

Management by capability units

In the following pages the capability units in the Pahranagat-Penoyer Areas are described and suggestions for the use and management of the soils are given. Discussed for each unit are the characteristics of the soils in the unit, the suitability of these soils for crops, and management suitable for the soils. To find the names of the soils in any given unit, refer to the "Guide to Mapping Units" at the back of this soil survey.

Soils in capability units IIw-69, IIw-9, IIIw-69P, IIIw-9P, and IVw-369P contain molybdenum that is taken up by forage plants in amounts that are toxic to livestock. Remedying the toxic effects of molybdenum in livestock is discussed in the subsection "Molybdenum Toxicity."

CAPABILITY UNIT I-1, IRRIGATED

This unit consists of moderately coarse textured and medium-textured soils on nearly level alluvial fans. These soils are well drained or moderately well drained and are more than 60 inches deep. Their permeability is moderate or moderately slow, but their available water capacity and inherent fertility are high. Although little or no erosion has occurred on these soils, some areas are covered with material that washed from higher lying soils during the high-intensity rainstorms. Included in the unit are some saline and saline-alkali soils that are now used for grazing.

The soils in this unit can be kept highly productive by using only a few practices. They are well suited to all crops suited to the climate and are used chiefly for small grain, alfalfa, and legume-grass mixtures for hay and pasture. The kind and the sequence of crops in a rotation depend partly on the supply of water available for

irrigation. The soils are friable, are easy to work, and respond to fertilizer. Cultivating them excessively, however, can result in less favorable tilth and reduce the intake of water.

These soils are not affected by a high water table, and a harmful rise in the ground water is not likely in irrigated fields that have been recently converted from brushland. Nevertheless, care in irrigating is essential to avoid building up the water table in lower lying soils. Salts can be removed from saline soils by leaching and by properly using irrigation water.

Leveling and smoothing are generally required before these soils can be brought under irrigation. Where leveling is needed, deep cuts can safely be made. The soils in this unit are highly suitable for irrigation, and water can be applied by almost any of the commonly used methods of irrigating.

CAPABILITY UNIT IIe-1, IRRIGATED

In this unit are moderately coarse textured soils that occupy small, gently sloping alluvial fans. These soils are well drained and are more than 40 inches deep. Some of them have a gravelly surface layer. Permeability is moderately rapid to moderately slow, and the available water capacity and inherent fertility are moderate to high. Little or no erosion has occurred on these soils, but some areas are covered with material that washed from higher lying soils during high-intensity rainstorms.

The soils in this unit can be protected from erosion and kept highly productive by using practices that are easily applied. They are well suited to all crops that do well in this climate, though they are generally used for small grain, alfalfa, or alfalfa-grass mixtures in fields where irrigation water is available. If soil-improving crops are grown in rotation with crops that return a large amount of residue to the soil, erosion is checked, good tilth is preserved, and favorable yields are maintained. The soils are friable or very friable, are easy to cultivate, and respond to fertilizer. Excessive cultivation should be avoided, however, because it increases erosion, impairs tilth, and reduces the water-intake rate.

Ditches used for irrigating these soils should be placed on the contour. To control washing in delivery ditches, drop structures should be built where needed. A suitable kind of irrigation is the corrugation method, but only a small stream of water should be used.

CAPABILITY UNIT IIw-2, IRRIGATED

This unit consists of medium-textured and moderately coarse textured soils on nearly level flood plains and toes of alluvial fans. These soils are somewhat poorly drained, and they are more than 60 inches deep. Their permeability is moderate or moderately rapid, and their available water capacity is moderate to high. Runoff is very slow, and erosion is not a hazard. Some of the soils are saline and are now used for grazing.

The soils in this unit are fertile, easy to work, and highly productive. They are well suited to all crops that can be successfully grown in this climate. Among these crops are small grain and either alfalfa or alfalfa-grass mixtures grown in rotation. The kind and the sequence of crops in a rotation are partly determined by the amount of irrigation water available. The response to fertilizer is good. These soils should be tilled only when necessary, as excessive cultivation can result in less favorable structure, impaired tilth, and reduced intake of water.

Artificial drainage is needed for removing excess water and maintaining a favorable salt balance. If the ground water is allowed to rise into the root zone of alfalfa and other deep-rooted crops, it brings harmful salts and alkali that can lower crop yields. Soluble salts can be leached from the root zone by irrigating properly. After the salinity has been reduced, a heavy irrigation is needed periodically to remove excess salts. In places that are difficult to irrigate properly, leveling may be required.

CAPABILITY UNIT IIw-6, IRRIGATED

This unit consists of medium-textured and moderately coarse textured soils that lie in nearly level areas on outer flood plains and toes of alluvial fans. These soils are more than 60 inches deep, are somewhat poorly drained, and are moderately or strongly affected by salts and alkali. They have moderately slow permeability and high available water capacity. They are fertile, easy to work, and productive. Runoff is slow or very slow, and there is little or no erosion.

The soils in this unit are used mainly for grazing, but they can be made suitable for irrigated crops if water becomes available. The concentration of salts and alkali can be reduced, though not completely removed, through irrigation and cultivation. Complete removal is not considered feasible.

These soils are suited to all salt- and alkali-tolerant crops that are suited to the climate. Among the suitable crops are barley, alfalfa, and alfalfa-grass grown in rotation, as well as grass-legume mixtures used for permanent pasture. Sugarbeets are suited, but other row crops are not. The crops selected for a rotation, and the number of years they are grown, depend on the supply of irrigation water available. Applying fertilizer increases the yields of all crops, but phosphate may be less available than other nutrients.

The sodium contained in these soils is harmful because it causes the clay particles to disperse in water. Then the soil puddles and seals over and, on drying, crusts on the surface. This delays or prevents the germination and emergence of seedlings, and it reduces the intake of water. Applying gypsum to the surface layer, and then leaching with a large amount of water, aids in removing excess sodium and helps prevent crusting. Light, frequent irrigations also keep the surface from drying out and crusting.

Artificial drainage is needed to control the water table during the irrigation season. Unless the soils are drained, the water table rises into the root zone of deep-rooted crops and brings an accumulation of excess salts and alkali.

CAPABILITY UNIT IIw-69, IRRIGATED

The soils in this unit are similar to those in unit IIw-6, but they contain molybdenum that is taken up by forage plants in amounts that are toxic to livestock. The soils occupy nearly level flood plains and the lower end of alluvial fans. They are very deep, moderately fine textured to moderately coarse textured, somewhat poorly drained, and saline-alkali. Permeability normally is moderately slow though it is slow in one of the soils, and the

available moisture capacity is high. Runoff is slow or very slow, and there is little or no risk of erosion.

These soils are fertile, have a high organic-matter content, are easy to work, and are highly productive. They can be used for all crops that are tolerant of salts and alkali and are suited to the climate. Among these crops are barely, alfalfa, alfalfa-grass in rotation, and legume-grass for permanent pasture. Except for sugar-beets, row crops are not suited. Species of clover should not be grown in pasture, because they take up more molybdenum than other plants. The crops selected for a rotation, as well as the length of time they are grown, depend on the supply of irrigation water available. Applying fertilizer increases the yield of all crops, but phosphate may be less available than other nutrients. Ammonium nitrate should not be used, because plants respond to this fertilizer by taking up more molybdenum.

Artificial drainage is needed for controlling the water table and for preventing an accumulation of salts and alkali in the root zone of deep-rooted crops. The concentration of salts and alkali can be reduced if the soils are irrigated and cultivated properly. Removing all the salts and alkali is not considered feasible. In addition, care in irrigating is essential to avoid raising the water table and to help maintain the stand of desirable plants by preventing root damage and the encroachment of undesirable plants.

Remedying the toxic effects of molybdenum in livestock is discussed in the subsection "Molybdenum Toxicity."

CAPABILITY UNIT IIw-9, IRRIGATED

This unit consists of medium-textured soils on nearly level flood plains. These soils are somewhat poorly drained and are more than 60 inches deep. They contain molybdenum that is taken up by forage plants in amounts that are toxic to livestock. Permeability is moderately slow, and the available water capacity is high. Runoff is slow or very slow, and there is little or no risk of erosion.

Lining the irrigation ditches and constructing drainage ditches have lowered the water table to a safe depth of 4 to 5 feet and have allowed a reduction of the salt content in the surface layer. The soils are suited to all crops that grow well in this climate. Among these crops are row crops, small grain, alfalfa, alfalfa and grass grown in rotation, and legumes and grasses used for permanent pasture. Species of clover should not be grown in pasture, however, because they take up more molybdenum than other plants. The crops selected for a rotation are partly determined by the amount of irrigation water available.

The response to fertilizer is good, but ammonium nitrate should not be used, because plants respond to this fertilizer by taking up more molybdenum. These soils should be tilled only when necessary, as excessive cultivation can result in less favorable structure, impaired tilth, and reduced intake of water.

The water table can be kept at a safe level if the soils are irrigated properly and if drainage ditches are maintained. This will prevent water damage to deep-rooted crops and an accumulation of excess salts and alkali in the root zone. An occasional heavy irrigation may be needed to keep the salt content low.

Remedying the toxic effects of molybdenum in livestock is discussed in the subsection "Molybdenum Toxicity."

CAPABILITY UNIT IIw-F, IRRIGATED

The soils in this unit occur on nearly level flood plains and in broad flood channels. They are well drained, more than 60 inches deep, and subject to occasional overflow. The gravelly, moderately coarse textured Fang soil is moderately susceptible to blowing. The silty Penoyer soil is slightly affected by salts and alkali. On both soils runoff is very slow, permeability is moderate or moderately slow, and the available water capacity is moderate to high. Water erosion is only slight, but some areas are covered with material that washed from higher lying soils during high-intensity rainstorms.

These soils are mainly in range that provides grazing for livestock, but they can be used as irrigated cropland if water is made available. They can be kept highly productive by using easily applied practices. The soils are well suited to all crops that grow well in this climate, including row crops, small grain, alfalfa, alfalfa and grass in rotation, and a legume-grass mixture for permanent pasture. These crops help to maintain fertility and good tilth. The soils are friable or very friable, are easy to cultivate, and respond to fertilizer. Excessive cultivation, however, can cause deterioration in tilth and reduce the intake of water. The excess salts and alkali in the Penoyer soil can be easily removed by irrigating and cultivating properly.

A high water table is not a limitation in these soils, and none should result in areas where brushland is converted to irrigated cropland. But using too much water on these soils can raise the water table in lower lying soils. Much of the salt and alkali can be removed by leaching, and the concentration can then be kept at a safe level through proper irrigation. Because the soils are subject to flooding and deposition, they should be protected by diversion structures or dikes.

Land leveling is generally needed to prepare these soils for irrigation. Cuts are not limited in depth. The soils are highly suitable for irrigation, and water can be applied by any of the common methods.

CAPABILITY UNIT IIs-4, IRRIGATED

This unit consists of moderately coarse textured soils that are slightly droughty because their available water capacity is only moderate. These soils lie on nearly level alluvial fans. They are well drained and are more than 60 inches deep. Runoff is slow or very slow, and permeability is moderately slow to moderately rapid. Soil blowing is a slight or moderate hazard, and in some areas there is deposition because of concentrated runoff from higher lying soils during high-intensity rainstorms.

The soils in this unit are used mainly as range that is grazed by livestock, but they are suitable for cropping if irrigation water is made available. They can be kept highly productive by using easily applied practices. All crops suited to the climate can be grown, but alfalfa or alfalfa-grass followed by row crops or small grain is the most suitable rotation. The specific crops selected for a rotation, and the number of years they are grown, depend on the supply of water available late in the irrigation season. All crops respond to added fertilizer. The soils are very friable and are easy to cultivate, but excessive

cultivation can result in less favorable tilth and in lower water-intake rate.

Clean tillage, if used continuously, aggravates the tendency of these soils to blow. To reduce the risk of soil blowing, windbreaks can be planted, a suitable crop rotation followed, and the surface protected by growing plants as much as possible.

These soils are not affected by a high water table, and the ground water is not likely to rise into the root zone if irrigation water is carefully managed. In some areas land leveling is needed to remove hummocks, and in others leveling or smoothing will improve the use of water. Furrow irrigation is used with row crops; other crops are grown with the border method. To offset droughtiness in these soils, water should be applied relatively often.

CAPABILITY UNIT IIs-6, IRRIGATED

This unit consists of moderately coarse textured and moderately fine textured soils that are affected by salts and alkali. These soils lie on nearly level alluvial fans and in flat basins. They are well drained and are more than 60 inches deep. Although their permeability is moderately slow or slow, their available water capacity and natural fertility are high. The soils are only slightly eroded, but in some areas they are covered with material that runoff brought down from higher lying soils during high-intensity rainstorms.

The soils in this unit are used mainly as range that is grazed by livestock, but they can be prepared for irrigation and used as cropland if water is made available. Only a few practices are needed for keeping the soils highly productive. All salt- and alkali-tolerant crops that are suited to the climate can be grown, but the most desirable crops are barley grown in rotation with alfalfa or alfalfa-grass, or a mixture of grasses and legumes used for pasture. The crops selected for a rotation, and the length of time they are grown, depend on the supply of irrigation water available. Yields of all crops are increased by additions of fertilizer, but phosphate may be less available than other nutrients.

Although the salts and alkali in these soils cannot be completely removed, their concentration can be lowered by irrigation and leaching. Because the soils lie in low positions, however, an outlet for leached salts cannot be provided through artificial drainage.

The water table in these soils is at a safe depth. Nevertheless, care in irrigating is necessary to avoid building up the ground water, which can injure deep-rooted crops. Land leveling is needed to prepare fields for irrigation, but the soils should not be left unprotected for long periods, because blowing is a hazard. Any common method of irrigating is suitable, depending on the kind of crop grown.

CAPABILITY UNIT IIs-L, IRRIGATED

The soils in this unit occur on nearly level alluvial fans and flood plains. They have a coarse-textured surface layer, are more than 60 inches deep, and are well drained. Their permeability is moderate or moderately rapid, and their available water capacity is moderate to high. Runoff is very slow, but soil blowing is a moderate hazard.

Although these soils are used mainly for grazing, they are suitable for development as irrigated cropland if water is made available. Only a few practices are needed to keep production high, but soil blowing is likely if the surface is left bare for long periods.

All crops suited to the climate do well on these soils, though small grains, alfalfa, alfalfa-grass mixtures, and other close-growing crops are best suited. Soil-improving crops should be grown in rotation with crops that return a large amount of residue to the soil, for this kind of cropping sequence preserves good tilth, maintains favorable yields, and helps to control soil blowing. The soils in this unit are very friable and easy to cultivate, and they respond to fertilizer. The number of tillage operations should be kept to the minimum, since excessive tillage can result in increased blowing, a deterioration in tilth, and reduced intake of water.

Some leveling may be needed for efficient control and use of water. Leveling cuts are not restricted, but the plan of leveling must be designed carefully so that deep depressions in a field are not filled with sandy material.

CAPABILITY UNIT IIIe-3, IRRIGATED

In this unit are moderately coarse textured, slowly permeable soils on gently sloping alluvial fans. These soils are well drained and are more than 36 inches deep. Some of them are gravelly. Although the soils in this unit have slow runoff, they are cut by drainage channels 1 to 4 feet deep that are washed periodically when water runs off higher lying soils. Consequently, the hazard of erosion is moderate to severe. The available water capacity is moderate.

These soils are used mainly as range that provides grazing, but they can be prepared and used for irrigated crops if water is made available. By managing the soils properly, productivity can be maintained. All crops suited to the climate grow well, but alfalfa and small grain grown in rotation, or grasses and legumes used for permanent pasture, are the best-suited crops. Applications of fertilizer increase yields. For controlling erosion, preserving good tilth, and maintaining favorable yields, a suitable rotation consists of a close-growing crop followed by a crop that returns a large amount of residue. The soils are friable or very friable and easily cultivated, but excessive cultivation should be avoided because it increases erosion, impairs tilth, and reduces the water-intake rate.

Leveling is needed to prepare the soils in this unit for irrigation. The leveling plan should be carefully designed, for a considerable amount of fill is required in some areas. In addition, cuts are limited because the soils are underlain by very gravelly sand that is weakly cemented with silica.

Because these soils are sloping and slowly permeable, they must be irrigated carefully. Ditches used for irrigating fields should be placed on the contour. To control washing in delivery ditches, drop structures should be built where needed to maintain a nonerosive grade. Corrugation irrigation is a suitable method of applying water. Only a small flow should be used in the corrugations.

CAPABILITY UNIT IIIe-4, IRRIGATED

This unit consists of gravelly, moderately coarse textured and moderately fine textured soils on gently

sloping alluvial fans. These soils are more than 60 inches deep. They are well drained or somewhat excessively drained, have moderate or moderately rapid permeability, and have low available water capacity. Natural fertility is moderate. Runoff is slow or very slow, and there is little or no risk of water erosion, but soil blowing is a hazard if the surface is left unprotected.

Although these soils are used only as range that is grazed by livestock, they are suitable for developing as irrigated cropland in areas where water is available. If they are well managed, the soils can be kept productive. All crops that grow well in this climate are suited to these soils. Best suited, however, are alfalfa and small grain grown in rotation or legumes and grasses used for permanent pasture. Yields are increased if fertilizer is applied. Good tilth can be maintained and yields kept favorable by farming in a rotation made up of soil-improving crops and crops that provide a large amount of residue. The soils are very friable and easy to cultivate. Excessive cultivation, however, tends to make the soils more erodible, causes deterioraation in tilth, and slows the intake of water.

Leveling or smoothing is needed to prepare these soils for irrigation. Leveling cuts should not be so deep that the very gravelly underlying material is exposed. To keep soil losses at a minimum, irrigation water should be applied carefully, especially while a crop is getting well established. To aid in the safe use of water, field ditches can be placed on the contour, and, where needed to control washing, drop structures can be built in delivery ditches.

If these soils are left bare for long periods, strong winds are likely to cause some loss of soil material.

CAPABILITY UNIT IIIw–136, IRRIGATED

This unit consists of moderately fine textured, slowly permeable, somewhat poorly drained soils on small, gently sloping alluvial fans. These soils are more than 60 inches deep. They contain excess soluble salts in the surface layer, and they have a water table that fluctuates between the depths of 30 and 42 inches. Natural fertility and the available water capacity are high. The root zone is very deep. Runoff is slow, and the hazard of erosion is only slight.

These soils are irrigated and used for crops, improved pasture, and meadow. The crops are alfalfa and small grain grown in rotation, and the meadow plants are cut for hay or are grazed. All crops that are tolerant of salts and are suited to the climate can be produced successfully on these soils, but soil-improving crops and those that return a large amount of residue are most desirable, for they help to control erosion and maintain good tilth and productivity. Although the soils are friable and easily cultivated, excessive cultivation can result in less favorable tilth and a reduced rate of water intake.

As a rule, care must be used in irrigating these soils to help control erosion and to keep the water table from rising. If the ground water rises in these soils, it can damage the roots of deep-rooted crops and cause a buildup of ground water in lower lying soils. Occasionally, however, a heavy irrigation is necessary so that soluble salts are leached from the surface layer and a favorable salt balance is maintained. In places that are difficult to irrigate properly, leveling may be needed.

CAPABILITY UNIT IIIw–69P, IRRIGATED

This unit consists of medium-textured and moderately fine textured, poorly drained soils that lie on nearly level flood plains. These soils are more than 60 inches deep. They contain molybdenum that is taken up by forage plants in amounts toxic to livestock. The water table fluctuates but is within 18 to 36 inches of the surface most of the year. The soils are affected by salts or by salts and alkali. Permeability is moderately slow. Natural fertility and the available water capacity are high. Runoff is very slow, and erosion is not a hazard.

These soils are fertile, have a high content of organic matter, are friable and easily worked, and can be kept productive. They can be used for crops that are suited to the climate and are tolerant of salts, alkali, and excess water. Mixtures of clover and grass, grown in long rotations with small grain, are well suited if they are cut for hay. But clover is undesirable in areas used for pasture, because it stores up excessive amounts of molybdenum from the soil and thus becomes toxic to grazing livestock. The soils respond to fertilizer, but phosphate may be less available than other nutrients. Ammonium nitrate should not be used, for it causes plants to take up an increased amount of molybdenum.

The concentration of salts and alkali in these soils can be reduced by irrigating and cultivating properly. Complete removal is not considered feasible. Artificial drainage is needed to keep the water table at a safe level, to prevent an increase in the content of salts in the root zone, and to help control the amount of molybdenum in the soil. Applying irrigation water carefully helps to avoid a rise in the level of ground water.

Controlling the toxic effects of molybdenum in livestock is discussed in the subsection "Molybdenum Toxicity."

CAPABILITY UNIT IIIw–9P, IRRIGATED

Only Pahranagat silt loam is in this unit. It is very deep, poorly drained soil that is free of excess salts and alkali, but it contains molybdenum that is taken up by forage plants in amounts that are toxic to livestock. The water table is between the depths of 18 and 36 inches throughout the year. Permeability is moderately slow, and the available water capacity and natural fertility are high. Runoff is very slow, and there is little or no risk of erosion.

This soil has a high organic-matter content, is friable and easily worked, and can be kept productive. It can be used for crops that are tolerant of excess water and are suited to the climate. A mixture of clover and grass, grown in a long rotation with small grain, is well suited if the plants are cut for hay. But clover is undesirable in areas used for pasture, because it stores up an excessive amount of molybdenum from the soil, and this becomes toxic to grazing livestock. The soil responds well to fertilizer. Ammonium nitrate should not be used, however, because plants respond to this fertilizer by taking up more molybdenum.

Artificial drainage is needed to keep the water table at a safe level. Providing drainage helps to maintain a stand of desirable plants by discouraging the invasion of

water-loving grasses. It also aids in preventing an increase in the content of salts in the root zone. Applying irrigation water carefully helps to avoid a rise in the level of ground water.

Controlling the toxic effects of molybdenum in livestock is discussed in the subsection "Molybdenum Toxicity."

CAPABILITY UNIT IIIs-3, IRRIGATED

This unit consists of very deep, gravelly, moderately coarse textured soils that are slowly permeable through the subsoil. These soils occupy the lower parts of well-drained alluvial fans. Their natural fertility and available water capacity are moderate. Although runoff is very slow and the erosion hazard is only slight, some areas are covered with material that washed from higher lying soils during high-intensity rainstorms. Included in this unit are areas of nongravelly soil and small areas in which the underlying material is stratified and cemented with silica.

The soils in this unit are in range that provides limited grazing for livestock. They can be developed as irrigated cropland if water is made available. They are suited to all crops that grow well in this climate, and they can be kept productive if management is good.

Among the crops best suited are alfalfa or alfalfa-grass grown in rotation with row crops or small grain, or legumes and grasses used for permanent pasture. Crops that return a large amount of residue to the soil, used in a sequence with close-growing crops, are desirable. The kinds and the sequence of crops in a rotation are determined by the amount of water that is available late in the irrigation season. Applying fertilizer increases the yields of all crops. The soils are friable and easy to cultivate, but cultivating them excessively can result in more erosion, less favorable tilth, and a reduced water-intake rate.

Some leveling is needed to prepare these soils for irrigation. Leveling cuts are limited by the slowly permeable subsoil and underlying cemented material, for this material should not be exposed. In irrigating, care must be taken to avoid a temporary perched water table over the slowly permeable subsoil.

CAPABILITY UNIT IIIs-4, IRRIGATED

In this unit are moderately coarse textured, well-drained or somewhat excessively drained soils that occupy nearly level alluvial fans. These soils consist of coarse sand or gravel below a depth of 20 to 36 inches. A few of the soils have a gravelly surface layer, and one, a Papoose soil, is slightly saline. Permeability is moderate to rapid, and the available water capacity is low to moderate. Natural fertility is moderate. Runoff is slow or very slow, but soil blowing is a slight to severe hazard. Some areas are covered with material that washed from higher lying soils during high-intensity rainstorms.

The soils in this unit are chiefly in range that is grazed by livestock, but they can be prepared and used for irrigated crops if enough water is made available. Keeping the soils productive requires good management and a large supply of irrigation water to offset droughtiness.

All crops suited to the climate can be grown successfully on these soils, but alfalfa and small grain in rotation, or legumes and grasses for pasture, are best suited. A desirable rotation is one in which a soil-improving crop is followed by a crop that returns a large amount of residue to the soil. All crops respond to additions of fertilizer. The soils are very friable and easily cultivated. Tilling those having a gravelly surface layer is not difficult.

These soils are not affected by a high water table, and the ground water is not likely to rise into the root zone if irrigation water is carefully managed. But using too much water on these soils can raise the water table in soils that lie at lower levels. Irrigating frequently will keep the surface moist and, as a result, will help prevent damage to crop seedlings from blowing soil particles. For added protection from wind, trees planted in windbreaks are needed in some places. If large areas are left bare, however, damage from soil blowing can be expected. Irrigating and cultivating properly will remove excess salts from the slightly saline Papoose soil.

Light leveling is needed to prepare these soils for irrigation. Leveling cuts generally are restricted to a depth of less than 6 inches because of the gravelly or sandy material in the lower part of the soils. In fields that have been leveled, border irrigation is the best method. In fields not suitable for leveling, corrugation irrigation is suggested.

CAPABILITY UNIT IIIs-L, IRRIGATED

The soils in this unit lie on nearly level alluvial fans and flood plains. They have a coarse-textured surface layer, are more than 60 inches deep, and are well drained or somewhat excessively drained. Their permeability is rapid to moderate, their available water capacity and natural fertility are low, and runoff is very slow or slow. The soils are only slightly eroded by water, but in some areas they are covered with material that runoff brought down from higher lying soils during high-intensity rainstorms. Soil blowing is a hazard if the surface is left unprotected.

The soils in this unit are in range that is grazed by livestock, but they can be prepared and used for irrigated crops if enough water is made available. Keeping the soils productive requires good management and a large supply of irrigation water to offset the low available water capacity.

All crops suited to the climate do well on these soils, though small grain, alfalfa, alfalfa-grass mixtures, and other close-growing crops are best suited. Soil-improving crops should be grown in rotation with crops that return a large amount of residue to the soils, for this kind of cropping sequence preserves good tilth, maintains favorable yields, and helps to control soil blowing. The soils are very friable, are easily cultivated, and respond to fertilizer. Tillage operations should be kept to the minimum since excessive tillage can result in increased blowing.

Some leveling may be needed for the efficient control and use of water. Leveling cuts generally should be kept to a depth of less than 12 inches, though cuts are not restricted in the Stumble and Sundown soils. In fields that have been leveled, border irrigation is the best method. In fields not suitable for leveling, sprinklers or corrugation irrigation is suggested.

CAPABILITY UNIT IVw-369P, IRRIGATED

This unit consists of slowly permeable, poorly drained, medium-textured and moderately fine textured soils on nearly level flood plains. These soils are more than 60 inches deep. They are affected by salts and alkali, and they contain molybdenum in amounts that can produce toxicity in grazing livestock. The water table is within 10 to 30 inches of the surface throughout the year. Runoff is very slow, and available water capacity and natural fertility are high.

If the soils in this unit are well managed, they can be kept productive. They are fertile and have a high organic-matter content. Nevertheless, their use and management are severely limited by wetness, slow permeability, salts and alkali, and molybdenum.

These soils are in meadow that is used for pasture or hay. They are suited to plants that are tolerant of excess salts and water, but only the most tolerant grasses, such as alta fescue or tall wheatgrass, should be grown. Another suitable plant is barley, which can be included in a rotation or seeded when a stand of grass needs replacing. Clover should not be grown, because it takes up an excessive amount of molybdenum and thus becomes toxic to livestock. Favorable yields can be expected if fertilizer is applied periodically, but ammonium nitrate is not suitable, for it causes plants to store up molybdenum.

Draining these soils is difficult because of their permeability and position, though excess surface water can be removed in shallow ditches. By irrigating properly and using shallow drains, some of the harmful salts and alkali can be removed. Complete removal, however, is not considered feasible. Applying gypsum increases the water-intake rate and helps to reduce crusting, which interferes with the establishment of a new crop.

If the soils are irrigated carefully, the water table can be kept from rising. In areas that are leveled, the depth of cuts is limited by the high water table.

Controlling the toxic effects of molybdenum in livestock is discussed in the subsection "Molybdenum Toxicity."

CAPABILITY UNIT Vw-2, IRRIGATED

In this unit are poorly drained and very poorly drained, chiefly medium-textured soils on nearly level flood plains and basins. These soils are more than 60 inches deep, and they are slightly affected by salts and alkali. They generally have a water table between the surface and a depth of 12 inches, but in some partially drained areas the water table is at a depth of 20 to 36 inches. The soils are subject to seepage and to runoff from slightly higher soils. Permeability ranges from moderately slow to moderately rapid, and natural fertility and the available water capacity are high or very high. The root zone is very deep. Runoff is very slow or ponded, and there is little or no erosion. Some layers of Peat are covered by a layer of mineral material washed from higher soils.

The soils in this unit are used for grazing and as habitat for migratory wildlife. They are too wet for cultivated crops. Unless drained, they cannot be safely crossed by heavy equipment, and they are difficult to drain because of their low position. Some of the excess water can be removed through small surface drains. If the Peat is drained, it will shrink and crack.

Carefully managing these soils improves the kind and amount of forage produced. If irrigation water is handled with care, the water table can be controlled. Controlled flooding, together with provisions for removing excess surface water, reduces the concentration of salts and alkali in the surface layer, helps to maintain the water table at its present level, and reduces the risk of ponding. Applying fertilizer aids in maintaining productivity. Yields of forage can be increased by growing water-tolerant plants that produce well.

CAPABILITY UNIT VIw-6, IRRIGATED

This unit consists of slowly permeable and very slowly permeable, poorly drained and somewhat poorly drained soils that are affected by salts and alkali. These soils lie in nearly level areas on alluvial fans and along the edge of flood plains adjacent to seeps, springs, and lakes. In these areas the water table fluctuates between the depths of 18 and 36 inches. The soils are moderately deep to very deep and are medium textured or fine textured. Runoff is slow or very slow, the root zone is moderately deep to very deep, and the available water capacity and natural fertility are low or high.

These soils are used for pasture consisting mostly of saltgrass. Although they are irrigated, they are not suitable for intensive cultivation. Using them for crops is impractical because of their position, high water table, slow and very slow permeability, and content of salts and alkali.

By managing irrigation water efficiently, the concentration of salts and alkali in the surface layer can be reduced, though its complete removal is not feasible. Fluctuations in the water table are controlled through proper irrigation. Shallow ditches on the contour can be used for irrigating and for removing surplus water from a field. To increase yields of pasture, seed a mixture of plants that are tolerant of the excess water, salts, and alkali.

CAPABILITY UNIT VIIw-6, DRYLAND

This unit consists of somewhat poorly drained, medium-textured and moderately coarse textured soils on nearly level flood plains and toes of alluvial fans. These soils are more than 60 inches deep. They have a fluctuating high water table and are affected by salts and alkali. The Ash Springs soil contains molybdenum that is taken up by some plants in amounts toxic to livestock. In all the soils permeability is moderately slow or moderate, the available water capacity and natural fertility are high, and the root zone is very deep. Runoff is slow or very slow and causes little or no erosion.

These dryland soils are used for grazing by livestock. Unless irrigated, the soils are not suitable for cultivation.

CAPABILITY UNIT VIIs-4, DRYLAND

This unit generally consists of moderately coarse textured soils that have low to moderate available water capacity and are somewhat droughty. These soils occupy nearly level to strongly sloping alluvial fans. They are more than 40 inches deep and are well drained or somewhat excessively drained. Some of the soils have a gravelly, stony, or very gravelly surface layer, and some areas are covered with material that washed from higher lying soils during high-intensity rainstorms. Runoff is

265-477—68——6

slow or very slow. Permeability generally is moderate or moderately rapid, but it ranges from slow to rapid. Natural fertility is low to high. Water erosion is a hazard on the stronger slopes and on the milder slopes that receive runoff from higher soils. The risk of soil blowing is slight to severe.

Included in the unit are soils in which the surface layer is coarse textured and the available water capacity is moderate or high. Also included is a small acreage of soils that are slightly affected by salts.

All the soils of this unit are in range, but their use for grazing is limited because rainfall is low. The response to management is not known.

CAPABILITY UNIT VIIs-6, DRYLAND

This unit consists of moderately coarse textured to moderately fine textured soils that have moderate to very slow permeability and are affected by excess salts and alkali. These nearly level soils occur on alluvial fans, on flood plains, and in basinlike areas. They are shallow or very deep and are well drained or moderately well drained. Their natural fertility and available water capacity range from low to high. Erosion is a slight to moderate hazard, and some areas are covered with material that washed from higher lying soils during high-intensity rainstorms.

The soils in this unit are used for limited grazing by livestock. Their response to range management is not known. Some of the soils are not suitable for cultivation, but most of them can be cultivated if water is available for irrigation.

CAPABILITY UNIT VIIs-7, DRYLAND

In this unit are rocky to extremely rocky, very stony or extremely stony, moderately coarse textured or medium-textured soils that are on gently sloping to extremely steep alluvial fans, foothills, and mountains. These soils generally are very shallow to moderately deep over bedrock or over a silica- or lime-cemented hardpan, and they are well drained or somewhat excessively drained. In most places their permeability is very slow, but it may range to moderate in soils overlying bedrock. The available water capacity is very low or low, and the inherent fertility is low or moderate. Runoff is slow to rapid, and the hazard of erosion is slight to severe.

Included in the unit is Leo extremely rocky sandy loam, 2 to 12 percent slopes, a soil that is deep and rapidly permeable.

The soils in this unit are sparse stands of desert plants that provide limited grazing for livestock and habitat for upland wildlife. Grazing is further limited by stones and rock outcrops. The soils are unsuitable for cultivation. Their response to management is not known.

CAPABILITY UNIT VIIs-8, DRYLAND

The soils in this unit generally are underlain by a hardpan indurated with silica or lime. They occupy nearly level to strongly sloping areas on alluvial fans, and they are well drained or somewhat excessively drained. Most of the soils are very shallow or shallow and are moderately coarse textured or medium textured. Some of them have gravel, cobblestones, or stones on the surface or in the surface layer. Permeability is very slow, the available water capacity is very low, and the inherent fertility is very low or low. Runoff is generally very slow to medium, and the hazard of erosion is slight or moderate.

Included in the unit are two coarse-textured Alko soils, the moderately deep Specter soil, and the Pintwater soil that is underlain by bedrock and has medium to rapid runoff.

The soils of this unit are in sparse stands of desert plants that provide limited grazing for livestock and habitat for upland wildlife. The soils are unsuitable for cultivation. Their response to management is not known.

CAPABILITY UNIT VIIs-L, DRYLAND

The soils in this unit are very deep, coarse textured, and somewhat excessively drained or excessively drained. Except for the Kawich soil, which lies on low dunes, these soils occupy nearly level to strongly sloping alluvial fans and flood plains. Some of them have gravel or stones on the surface or in the surface layer. Permeability is rapid or very rapid, and runoff is very slow or slow. The available water capacity and natural fertility are very low or low. Water erosion is a slight to moderate hazard, and some areas are covered with material that washed from higher lying soils during high-intensity rainstorms. The risk of soil blowing is slight to severe.

The soils in this unit are used for limited grazing by livestock. Their response to range management is not known. The less droughty soils of the unit can be developed as irrigated cropland if water is made available.

CAPABILITY UNIT VIIc-K, DRYLAND

This unit consists of medium-textured and moderately coarse textured soils that are more than 60 inches deep and are well drained or moderately well drained. These soils occupy nearly level or gently sloping alluvial fans and flood plains in areas where rainfall is insufficient for seeding perennial grass. Some of the Fang soils are gravelly. Permeability is moderate or moderately slow, and the available water capacity and natural fertility are high. Runoff is slow or very slow. The hazard of erosion is slight or moderate. Some areas are covered with material deposited by concentrated runoff from higher lying soils.

The soils in this unit are used to provide limited grazing for livestock. If water were available for irrigation, the soils would be well suited to cultivated crops.

CAPABILITY UNIT VIIIw-F, DRYLAND

In this unit is Playa, a land type that is nearly level and slightly concave. It consists of fine-textured, poorly drained soil material that is more than 60 inches deep, is subject to overflow, and is affected by salts and alkali. Because runoff is ponded and permeability is very slow, Playa is covered with water at times when rainfall is abnormally heavy or, in summer, is of high intensity. The water forms a playa lake and then is evaporated. There is little or no erosion.

Although a few salt- and alkali-tolerant plants grow along the margin, Playa generally is barren. It is not suitable as irrigated cropland or as range.

CAPABILITY UNIT VIIIs-6, DRYLAND

Two land types—Clay dune land and Slickens—are in this unit. Clay dune land consists of clay that lies in

mounds 3 to 12 feet high on the surface of the Playa in Penoyer Valley. The clay is slowly permeable but it is well drained, and it is affected by salts and alkali. Only a few plants grow on the dunes, which have very rapid runoff and are highly erodible.

Slickens are tailings, or refuse materials, deposited below a mill in Penoyer Valley. They are very deep, are coarse textured, and are moderately susceptible to blowing. Runoff is very slow, permeability is moderately rapid, and the available water capacity and inherent fertility are low. Slickens support little vegetation.

No use is made of these land types, though some areas could be made useful as wildlife habitat.

CAPABILITY UNIT VIIIs-7, DRYLAND

In this unit is Rock land, a land type consisting of very shallow soil material and large outcrops or mounds of rock. Slopes range from moderate to nearly vertical. Little or no vegetation grows on this land.

Rock land is not suitable as range, but it can be used as watershed areas, recreational areas, or habitat for wildlife.

Estimated Yields

Table 3 lists average acre yields of barley, alfalfa, and pasture that can be expected on irrigated soils in the Pahranagat-Penoyer Areas under two levels of management. In columns A are yields that can be expected under common, or prevailing, management. In columns B are yields that can be expected under the highest level of management that is now feasible. Table 3 also lists, for soils used as range, the total annual yield of natural vegetation in years of favorable and of unfavorable rainfall. Total annual yield is expressed as air-dry pounds per acre.

The estimates were prepared cooperatively by the Soil Conservation Service, the Nevada Agricultural Experiment Station, the Nevada Extension Service, and selected farmers and ranchers. Yields for Clay dune land-Playa association, Rock land, and Slickens are not listed in the table.

Several important limitations should be kept in mind when using table 3. First, the yield figures are estimates, or predictions, rather than proven facts, but they are considered reliable enough to be valuable. Second, the

TABLE 3.—*Estimated average yields per acre of selected crops*

[Yields in columns A are those obtained under prevailing management; yields in columns B are those expected under the best management practical. Listed in last two columns on right are total annual yields of natural vegetation in excellent condition on soils used as range; they are the yields obtained in years of favorable and of unfavorable rainfall. Absence of yield indicates the crop is not commonly grown on the soil]

Map symbol	Soil	Barley A	Barley B	Alfalfa A	Alfalfa B	Irrigated pasture A	Irrigated pasture B	Range Favorable	Range Unfavorable
		Bu.	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Lbs.*	*Lbs.*
Ad	Adaven loam					0. 5	1. 8		
AkB	Alko loamy coarse sand, 0 to 8 percent slopes							300	150
AlB	Alko stony loamy coarse sand, 0 to 8 percent slopes							200	150
AmB	Alko-Tickapoo-Rock land association, 2 to 8 percent slopes:								
	Alko gravelly loam, 2 to 4 percent slopes							400	200
	Tickapoo stony sandy loam, 2 to 8 percent slopes							400	200
An	Ash Springs fine sandy loam, somewhat poorly drained							1, 000	500
Ao	Ash Springs silt loam					. 9	3. 7		
Ap	Ash Springs silt loam, somewhat poorly drained	55	70	4. 5	5. 4	. 9	3. 7		
Ar	Ash Springs silt loam, reclaimed	60	75	5. 0	6. 0	1. 2	4. 0		
As	Ash Springs silty clay loam					. 7	3. 3		
At	Ash Springs silt loam, heavy subsoil variant, somewhat poorly drained.	55	70	4. 5	5. 4	. 9	3. 7		
Au	Ash Springs silt loam, heavy subsoil variant, slightly saline.					. 7	3. 3		
Av	Ash Springs silty clay loam, heavy subsoil variant, slightly saline.					. 7	3. 3		
AyA	Aysees gravelly sandy loam, 0 to 2 percent slopes							350	175
AyB	Aysees gravelly sandy loam, 2 to 4 percent slopes							350	175
Ba	Bastian fine sandy loam, strongly saline							1, 000	800
Bc	Bastian silt loam, moderately saline							1, 000	800
Bd	Bastian silt loam, strongly saline							1, 000	800
Bs	Belted sandy loam							300	150
BuC	Bluewing very gravelly loamy sand, 2 to 12 percent slopes.							350	175
CaC	Carrizo gravelly sand, 0 to 12 percent slopes							200	150
CbC	Carrizo stony loamy sand, 0 to 12 percent slopes							200	150
CfA	Cliffdown gravelly sandy loam, 0 to 2 percent slopes							450	225
CfB2	Cliffdown gravelly sandy loam, 2 to 4 percent slopes, eroded.							450	225
ChA	Cliffdown loamy sand, 0 to 2 percent slopes							400	200
CkB	Cliffdown sandy loam, 2 to 4 percent slopes							400	200
ClB2	Cliffdown very gravelly sandy loam, 2 to 4 percent slopes, eroded.							350	175

TABLE 3.—*Estimated average yields per acre of selected crops*—Continued

Map symbol	Soil	Barley		Alfalfa		Irrigated pasture		Range	
		A	B	A	B	A	B	Favorable	Unfavorable
		Bu.	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Lbs.*	*Lbs.*
CmC	Crystal Springs cobbly fine sandy loam, 2 to 8 percent slopes.	---	---	---	---	---	---	300	150
CnB	Crystal Springs gravelly loam, 2 to 4 percent slopes	---	---	---	---	---	---	300	150
CsB	Crystal Springs-Cliffdown association, 2 to 4 percent slopes:								
	Crystal Springs gravelly loam, 2 to 4 percent slopes	---	---	---	---	---	---	300	150
	Cliffdown gravelly sandy loam, 2 to 4 percent slopes, eroded.	---	---	---	---	---	---	450	225
FaA	Fang fine sandy loam, 0 to 2 percent slopes	---	---	---	---	---	---	400	200
FaB	Fang fine sandy loam, 2 to 4 percent slopes	---	---	---	---	---	---	400	200
FgA	Fang gravelly fine sandy loam, overflow, 0 to 2 percent slopes.	---	---	---	---	---	---	400	200
FhB	Fang gravelly sandy loam, 2 to 4 percent slopes	---	---	---	---	---	---	300	150
FlA	Fang loamy fine sand, 0 to 2 percent slopes	---	---	---	---	---	---	400	200
FmA	Fang loamy fine sand, overblown, 0 to 2 percent slopes	---	---	---	---	---	---	400	200
FnA	Fang sandy loam, 0 to 2 percent slopes	---	---	---	---	---	---	300	150
FpA	Fang sandy loam, slightly saline-alkali, 0 to 2 percent slopes.	---	---	---	---	---	---	300	150
FrB	Fang sandy loam, deep, 2 to 4 percent slopes	---	---	---	---	---	---	350	400
FsB	Fang-Nyala association, 2 to 4 percent slopes:								
	Fang fine sandy loam, 2 to 4 percent slopes	---	---	---	---	---	---	400	200
	Nyala fine sandy loam, 2 to 4 percent slopes	---	---	---	---	---	---	300	150
Ge	Geer fine sandy loam	---	---	---	---	---	---	700	350
Gf	Geer fine sandy loam, slightly saline	---	---	---	---	---	---	1,000	1,200
Gh	Geer fine sandy loam, water table, strongly saline	---	---	---	---	---	---	700	350
Gk	Geer silt loam	60	75	5.5	6.0	3.0	5.0	700	350
Gl	Geer silt loam, water table	60	75	4.0	5.5	1.3	4.0	---	---
Gm	Geer silt loam, water table, moderately saline	---	---	---	---	---	---	700	350
Gn	Geer silt loam, water table, slightly saline	---	---	---	---	---	---	1,000	1,200
Ja	Jarboe sandy loam, saline-alkali	---	---	---	---	---	---	350	200
Jb	Jarboe very fine sandy loam, strongly saline-alkali	---	---	---	---	---	---	350	200
Kp	Kawich-Playa complex:								
	Kawich fine sand, 0 to 12 percent slopes							200	150
	Playa	---	---	---	---	---	---	---	---
KsB	Koyen sandy loam, 2 to 4 percent slopes	---	---	---	---	---	---	400	200
KtB	Koyen-Tickapoo association, 2 to 4 percent slopes:								
	Koyen sandy loam, 2 to 4 percent slopes	---	---	---	---	---	---	400	200
	Tickapoo sandy loam, 2 to 4 percent slopes	---	---	---	---	---	---	400	400
LaA	Lahontan fine sandy loam, water table variant, 0 to 2 percent slopes.	55	70	4.0	5.0	1.1	4.0	---	---
LaB	Lahontan fine sandy loam, water table variant, 2 to 4 percent slopes.	55	70	4.0	5.0	1.1	4.0	---	---
LhA	Lahontan silt loam, water table variant, 0 to 2 percent slopes.	---	---	---	---	1.0	3.0	---	---
LhB	Lahontan silt loam, water table variant, 2 to 4 percent slopes.	---	---	---	---	1.0	3.0	---	---
LmA	Lahontan silt loam, water table variant, moderately saline, 0 to 2 percent slopes.	---	---	---	---	.6	2.3	---	---
Ln	Lahontan silty clay, poorly drained variant	---	---	---	---	.4	2.0	---	---
LrC	Leo extremely rocky sandy loam, 2 to 12 percent slopes	---	---	---	---	---	---	350	175
LsC	Leo gravelly sandy loam, 2 to 12 percent slopes	---	---	---	---	---	---	400	200
MkC	Maynard Lake gravelly soils, 4 to 12 percent slopes	---	---	---	---	---	---	200	150
MlB	Maynard Lake loamy sand, 0 to 4 percent slopes	---	---	---	---	---	---	200	150
MlC	Maynard Lake loamy sand, 4 to 12 percent slopes	---	---	---	---	---	---	200	150
Mn	McCutchen loam	---	---	---	---	---	---	300	150
Mr	Monte Cristo fine sandy loam	---	---	---	---	---	---	300	150
NeD	Nevoyer gravelly loam, 4 to 12 percent slopes	---	---	---	---	---	---	350	175
Pa	Pahranagat silt loam	---	---	---	---	1.1	4.2	---	---
Pb	Pahranagat silt loam, drained	60	75	4.5	6.0	1.2	4.8	---	---
Pc	Pahranagat silt loam, drained, slightly saline	40	50	4.0	5.4	.8	4.0	---	---
Pd	Pahranagat silt loam, slightly saline	---	---	---	---	.8	4.0	---	---
Pe	Pahranagat-Ash Springs complex:								
	Pahranagat silt loam, slightly saline	---	---	---	---	.8	4.0	---	---
	Ash Springs silt loam	---	---	---	---	.9	3.7	---	---
Pg	Pahranagat-Ash Springs complex, seeped:								
	Pahranagat silt loam, seeped, slightly saline	---	---	---	---	.9	2.0	---	---
	Ash Springs silt loam, seeped, slightly saline	---	---	---	---	.9	2.0	---	---

TABLE 3.—*Estimated average yields per acre of selected crops*—Continued

Map symbol	Soil	Barley		Alfalfa		Irrigated pasture		Range	
		A	B	A	B	A	B	Favorable	Unfavorable
		Bu.	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Lbs.*	*Lbs.*
Ph	Pahranagat-Ash Springs variant complex:								
	Pahranagat silt loam, slightly saline	--	--	--	--	0. 8	9. 0	--	--
	Ash Springs silty clay loam, heavy subsoil variant, slightly saline.	--	--	--	--	. 7	3. 3	--	--
Pk	Pahranagat-Ash Springs variant complex, drained:								
	Pahranagat silt loam, drained, slightly saline	--	--	--	--	. 8	4. 0	--	--
	Ash Springs silt loam, heavy subsoil variant, somewhat poorly drained, slightly saline.	--	--	--	--	. 8	3. 7	--	--
PlC	Pahroc gravelly loam, 2 to 8 percent slopes	--	--	--	--	--	--	400	200
PmA	Papoose loamy fine sand, 0 to 2 percent slopes	--	--	--	--	--	--	400	200
PnA	Papoose sandy loam, 0 to 2 percent slopes	--	--	--	--	--	--	400	200
PnA2	Papoose sandy loam, 0 to 2 percent slopes, eroded	--	--	--	--	--	--	350	175
PnB	Papoose sandy loam, 2 to 4 percent slopes	--	--	--	--	--	--	400	200
PoA	Papoose sandy loam, slightly saline, 0 to 2 percent slopes	--	--	--	--	--	--	300	150
Pp	Peat	--	--	--	--	. 9	2. 8	--	--
Pr	Penoyer loam, moderately saline-alkali	--	--	--	--	--	--	350	200
Ps	Penoyer loam, slightly saline-alkali	--	--	--	--	--	--	350	200
Pt	Penoyer silt loam	55	70	5. 0	6. 0	3. 0	4. 8	450	225
Pu	Penoyer silt loam, slightly saline-alkali	--	--	--	--	--	--	350	200
PvE	Pintwater rocky sandy loam, 12 to 45 percent slopes	--	--	--	--	--	--	300	150
Pw	Puddle fine sandy loam	--	--	--	--	--	--	300	150
SaA	Seaman fine sandy loam, hummocky, 0 to 2 percent slopes.	--	--	--	--	--	--	200	150
SbA	Seaman loamy fine sand, 0 to 2 percent slopes	--	--	--	--	--	--	200	150
ScA	Seaman sandy loam, 0 to 2 percent slopes	--	--	--	--	--	--	200	150
ScB	Seaman sandy loam, 2 to 4 percent slopes	--	--	--	--	--	--	200	150
SdA	Seaman sandy loam, water table, slightly saline, 0 to 2 percent slopes.	--	--	--	--	--	--	700	350
SeA	Seaman sandy loam, water table, strongly saline, 0 to 2 percent slopes.	--	--	--	--	--	--	700	350
SfC	Sierocliff extremely stony very fine sandy loam, 4 to 12 percent slopes.	--	--	--	--	--	--	350	175
SgC	Silent gravelly loam, 2 to 12 percent slopes	--	--	--	--	--	--	350	175
ShB	Silent gravelly sandy loam, 2 to 4 percent slopes	--	--	--	--	--	--	350	175
SkD	Silent very rocky loam, 4 to 12 percent slopes	--	--	--	--	--	--	300	150
SlD	Silverbow extremely stony very fine sandy loam, 8 to 12 percent slopes.	--	--	--	--	--	--	300	150
SnC2	Specter gravelly loam, 2 to 12 percent slopes, eroded	--	--	--	--	--	--	300	150
St	Stumble loamy sand	--	--	--	--	--	--	400	200
Su	Stumble loamy sand, deep	--	--	--	--	--	--	400	200
SvA2	Sundown loamy sand, 0 to 2 percent slopes, eroded	--	--	--	--	--	--	400	200
SwA	Sundown sandy loam, 0 to 2 percent slopes	--	--	--	--	--	--	400	200
SyB2	Sundown very gravelly loamy sand, 2 to 4 percent slopes, eroded.	--	--	--	--	--	--	400	200
TaF	Theriot extremely rocky loam, 30 to 100 percent slopes	--	--	--	--	--	--	200	150
TcA	Tickapoo gravelly fine sandy loam, 0 to 2 percent slopes	--	--	--	--	--	--	350	175
TdB	Tickapoo gravelly sandy loam, 2 to 4 percent slopes	--	--	--	--	--	--	350	175
TdB2	Tickapoo gravelly sandy loam, 2 to 4 percent slopes, eroded.	--	--	--	--	--	--	400	200
TkB	Tickapoo sandy loam, 2 to 4 percent slopes	--	--	--	--	--	--	400	200
TlC	Tickapoo-Leo association, 4 to 12 percent slopes:								
	Tickapoo gravelly sandy loam, 4 to 12 percent slopes.	--	--	--	--	--	--	350	175
	Leo gravelly sandy loam, 4 to 12 percent slopes	--	--	--	--	--	--	400	200
TmC	Timpahute very stony clay loam, 2 to 12 percent slopes	--	--	--	--	--	--	450	225
TnC	Timpahute-Leo association, 2 to 12 percent slopes:								
	Timpahute very stony clay loam, 2 to 12 percent slopes.	--	--	--	--	--	--	450	225
	Leo gravelly sandy loam, 2 to 12 percent slopes	--	--	--	--	--	--	400	200
Tp	Timper sandy loam	--	--	--	--	--	--	350	150
Tr	Tippipah sandy loam	--	--	--	--	--	--	300	150
TsD	Tolicha extremely stony very fine sandy loam, 4 to 12 percent slopes.	--	--	--	--	--	--	300	150
TuD	Tufa rock land-Kawich association, 0 to 12 percent slopes:								
	Tufa rock land	--	--	--	--	--	--	--	--
	Kawich fine sand, 0 to 12 percent slopes	--	--	--	--	--	--	200	150
Wc	Woodrow clay loam	--	--	--	--	--	--	350	200

estimates are of average yields that may be expected over a period of many years. Yields may be above or below the average in any particular year. Third, there are variations in yield among areas of the same soil. Fourth, past management of a soil affects its immediate response to new management practices. Fifth, new crop varieties and improved farming practices are likely to increase future yields. Sixth, the availability of competent management on the farm has an influence on yields.

Yields in columns A are obtained under the management in the Pahranagat-Penoyer Areas. Under this management the crop rotation followed is too long for maximum production; little fertilizer and barnyard manure are used; irrigation water is not always applied uniformly and may not be in sufficient amounts at the proper time; there is little control of insect pests and weeds; and the practices used in preparing a seedbed and in cultivating can be improved.

Farmers who obtain the yields in columns B follow the practices suggested for each capability unit. They also—

1. Use a planned rotation of crops.
2. Apply fertilizer at the following times and rates per acre:
   - For small grain, 40 pounds of nitrogen and 10 pounds of phosphorus applied at planting times.
   - For alfalfa, 30 pounds of nitrogen and 18 pounds of phosphorus applied at planting time.
   - To keep alfalfa productive, 18 pounds of phosphorus applied every other year.
   - For potatoes, 50 pounds of nitrogen and 27 pounds of phosphorus applied in either one or two applications.
   - For sugarbeets, 80 pounds of nitrogen if they follow alfalfa in the rotation; or if they follow small grain in the rotation, 120 pounds of nitrogen applied in two applications, the first before planting time, the second as side dressing before the young plants are thinned.
3. Add barnyard manure, as available, at the rate of 10 tons per acre.
4. Level the soil for efficient irrigation.
5. Apply water carefully at the right time and in the amounts needed.
6. Use gypsum for improving alkali soils according to the needs indicated by soil analyses.
7. Control weeds and insect pests.

Managing Soils for Wildlife

The Pahranagat Valley supports several kinds of wildlife that provide recreation and contribute to the economy of the area. The most important kinds are migratory ducks and geese. During their annual migrations, these birds feed and rest on the wet, low-lying soils near the springs and lakes on the flood plain. A few ducks and geese nest here and remain throughout the year.

In cultivated areas the common upland game are Gambel quail and mourning dove. These birds are plentiful all year. Attempts to introduce pheasant have met with little success, and other species of upland wildlife released in the valley have not survived.

The lakes in Pahranagat Valley would provide good habitat for bass, bluegill, and other warm-water fish if the level of the lakes could be controlled. In summer, however, the water is drawn down so heavily for irrigation that its use for fish is limited. Muskrats and other furbearers inhabit areas adjacent to the lakes and along some of the ditches in the valley.

Cottontail rabbits and jackrabbits live in upland areas but are most abundant near cultivated fields. A mule deer can be seen occasionally in a cultivated field or near a patch of dense willows.

In the Penoyer Valley there are few species of wildlife because water and suitable habitat are scarce. If the playa is covered with water, a few ducks may rest on it during their spring or fall migration. Although no upland birds have been seen, a few cottontail rabbits and jackrabbits inhabit the area. Occasionally a pronghorn antelope is observed, but it likely is only migrating through the valley.

Suitability of soils for wildlife

In the Pahranagat-Penoyer Areas, the suitability of the soils as habitats for wildlife is related to the use of the soil, the kind and density of the plant cover, the availability of irrigation water, and the relief. It also depends on drainage, permeability, the salt and alkali content, and other characteristics or qualities of the soils.

In the Pahranagat Valley, much of the natural habitat has been changed by growing cultivated crops and pasture. Some of the wet areas have been drained by lining irrigation canals and constructing deep ditches. Raising the height of dams has enlarged the lakes.

In contrast, few changes have occurred in Penoyer Valley. Most of the natural vegetation remains there, and almost no habitat exists for upland wildlife. Cultivated crops are grown in a few areas where ground water is pumped for irrigation. As the acreage under cultivation is increased in this valley, the habitat suitable for upland wildlife will be enlarged.

Wildlife sites

The soils of the Pahranagat-Penoyer Areas have been placed in 11 wildlife sites according to their limitations for use as habitat and their suitability for four classes of wildlife. These wildlife sites are listed in table 4. Each site is made up of soils that can provide about the same kind and amount of food and cover and that respond to management in about the same way. To find the names of the soils in any given site, refer to the "Guide to Mapping Units" at the back of this soil survey.

Considered in rating the limitations and the suitability of each wildlife site were the kinds of plants suitable for each of the four classes of wildlife, and, for wetland wildlife, the limitations of the soils for impounding water.

Grain crops, grasses and legumes, and the hedgerow cover provided by native shrubs are suitable habitat for upland wildlife, including pheasant, valley quail, and mourning dove.

Grasses, legumes, and native shrubs are suitable habitat for cottontail rabbit and other kinds of rangeland wildlife.

Grain crops, grasses and legumes, and impoundments

TABLE 4.—*Wildlife sites, their limitations for use as habitat, and their suitability for four kinds of wildlife*

Wildlife site	Habitat limitations for—					Suitability for—			
	Grain crops	Grasses and legumes	Native shrubs	Shallow-water impoundments	Deep-water impoundments	Upland wildlife	Rangeland wildlife	Migratory wetland wildlife	Nonmigratory wetland wildlife
Site 1	None to slight.	None to slight.	Very severe	Very severe	Very severe	Excellent	Not suited	Not suited	Not suited.
Site 2	None to slight.	None to slight.	Severe	Very severe	Very severe	Excellent to poor[1].	Poor	Not suited	Not suited.
Site 3	Moderate	Moderate	Very severe	Very severe	Very severe	Good to poor[1].	Not suited	Not suited	Not suited.
Site 4	Moderate	Moderate	Severe	Very severe	Very severe	Good to poor[1].	Poor	Not suited	Not suited.
Site 5	Severe	Severe	Very severe	Very severe	Very severe	Poor	Not suited	Not suited	Not suited.
Site 6	None to slight.	None to slight.	Very severe	Moderate	Very severe	Excellent to poor[1].	Not suited	Good	Not suited.
Site 7	Moderate	Moderate	Very severe	Moderate	Very severe	Good to poor[1].	Not suited	Good	Not suited.
Site 8	Moderate	Moderate	Severe	Severe	Very severe	Good to poor[1].	Poor	Poor	Not suited.
Site 9	Severe	Severe	Severe	Severe	Very severe	Poor	Poor	Poor	Not suited.
Site 10	Severe	Severe	Very severe	Moderate	Severe	Poor	Not suited	Good	Poor.
Site 11	Very severe	Very severe	Very severe	None to slight.	Severe	Not suited	Not suited	Excellent	Poor.

[1] Rating depends on species of wildlife and variations in climate.

of shallow water are suitable for ducks, geese, and other kinds of migratory wetland wildlife.

Impoundments of deep water are suitable for nonmigratory wildlife, including muskrat.

The limitations of a site as habitat are *none to slight* if the specified kind of food and cover or type of water impoundment is more desirable than the average; *moderate*, if the desirability is about average; *severe* if the desirability is below the average; and *very severe* if the specified item in the habitat is not useful to, or is not needed by, the wildlife.

The suitability of each site for kinds of wildlife is *excellent* if little management is needed to maintain or increase the wildlife in the named class. It is *good* if average management of the site is needed. Suitability is *poor* if wildlife can be maintained only with difficulty. The site is *not suited* if maintenance of the specified wildlife is not feasible or is impossible.

The placement of soils in the 11 wildlife sites is based on the assumption that adequate water is made available for irrigation. Soils on uplands that are not suitable for irrigation have not been placed in a site, because little or no wildlife inhabits these soils at the present time.

Engineering Uses of Soils

This subsection provides information, in tabular form, about the engineering properties of soils in the Pahranagat-Penoyer Areas. With the use of the soil map for identification, the information can be useful for many purposes. It will help in planning and locating sites for structures; in eliminating tests of materials obviously unsuited to a specific use; in locating materials suitable for the type of structure planned; in determining the most favorable location, design, and construction for certain structures of a low-hazard type that normally are built on the basis of general experience in the survey areas; and in predicting problems in construction and maintenance.

The engineering interpretations in this subsection will be most useful to engineers and others who have a working knowledge of the principles of soil mechanics and have some familiarity with engineering groupings of soils. These interpretations have been developed largely from field observations and evaluations. It should be emphasized that they may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some of the terms used by soil scientists may not be familiar to the engineer, and some terms may have special meaning in soil science. Several of these terms are defined in the Glossary at the back of this survey.

Engineering classification systems

Agricultural scientists of the U.S. Department of Agriculture classify soils according to texture. In some ways this system of naming textural classes is comparable to the two main systems used by engineers for classifying soils: the system of the American Association of State Highway Officials (AASHO) and the Unified system.

The AASHO and the Unified systems are based on the identification of soils in accordance with their texture, that is, the percentage of gravel, sand, and fines (silt and clay), and with their plasticity and compressibility characteristics as indicated by the liquid limit, plasticity index, and consistence; and with their behavior as engineering construction material.

In the AASHO system (*1*), soil material is classified in seven principal groups. The groups range from A-1, consisting of gravelly or sandy soils of high bearing capacity, to A-7, consisting of clayey soils having low strength when wet. Within each group the relative engineering value of the material is indicated by a group index number. The numbers range from 0 for the best material to 20 for the poorest. The group index number, if it has been determined, is shown in parentheses following the soil group symbol. Group index numbers have not been designated for soils in the Pahranagat-Penoyer Areas, because there is a lack of specific test data necessary for calculating this value.

The Unified soil classification system was established by the United States Army, Corps of Engineers (*12*). It is based on identification of soils according to their texture and plasticity and their performance as engineering construction materials. In the Unified system, soils are identified as coarse grained (8 classes), fine grained (6 classes), and highly organic (1 class). For example, the symbols SM and SC represent sand with fines of silt and of clay, respectively; ML and CL, silts and clays having low liquid limit; MH and CH, silts and clays having high liquid limit; and GP and GM, gravel-sand and gravel-sand-silt mixtures. Some soil materials have characteristics that are in a border zone between two major classes and are given a borderline classification, such as CL-CH.

Estimated properties of the soils

Table 5 shows some estimated soil properties that are important in engineering, and it gives estimated Unified and AASHO classifications for the soils. The textural terms used to describe the soil material in the major horizons are those used by the U.S. Department of Agriculture. For some soils the data are based on the results of laboratory tests.

TABLE 5.—*Estimated*

[Dashes indicate information is not available

Soil and map symbol	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Adaven (Ad).	0-24	Loam	CL or ML	A-4
	24-39	Hardpan	---	---
	39-60	Sandy loam	SM	A-2
Alko (AkB, AlB, AmB). (For properties of the Tickapoo soil in mapping unit AmB, refer to the Tickapoo series in this table. Properties of Rock land in AmB were not estimated.)	0-11	Loamy coarse sand	SM	A-2 or A-1-b
	11-33	Hardpan	---	---
	33-50	Coarse sand	SW or SM	A-1-b
Ash Springs: (An).	0-18	Fine sandy loam	SM	A-4
	18-33	Silt loam	ML or GM	A-4
	33-43	Silt loam	ML or CL	A-4 or A-6
(Ao, Ap, Ar, As, Pe).	0-24	Silt loam	ML or CL	A-4
	24-37	Silt loam	ML or GM	A-4 or A-6
	37-43	Silt loam	ML or CL	A-4 or A-6
(At, Au, Av, Ph, Pk).	0-20	Silty clay loam	CH	A-6
	20-60	Clay	CH	A-7
(Pg).	0-24	Silt loam	OL or ML	A-4
	24-37	Silt loam	ML, CL, or SM	A-4
	37-43	Silt loam	OL	A-4
Aysees: (AyA, AyB).	0-22	Gravelly sandy loam	SM or GM	A-2 or A-4
	22-60	Very gravelly sand	GP or GW	A-1-a
Bastian: (Ba).	0-12	Fine sandy loam	SM or ML	A-4
	12-50	Silt loam	ML or SM	A-4
	50-60	Fine sandy loam	SM or ML	A-4 or A-2
(Bc, Bd).	0-16	Silt loam	ML or CL	A-4
	16-50	Silt loam	ML or SM	A-4
	50-60	Fine sandy loam	SM or ML	A-4 or A-2
Belted (Bs).	0-7	Sandy clay loam	SC or SM	A-6 or A-2
	7-11	Hardpan	---	---
	11-32	Sandy loam	SM	A-2
	32-60	Silt loam	ML or CL	A-4 or A-6

See footnotes at end of table.

An explanation of some of the terms in table 5 may be helpful. Permeability, or the rate that water moves through soil material, was estimated for uncompacted soil.

Available water-holding capacity is the amount of water a soil can hold available for plants. It is the water held in the range between field capacity and the wilting point.

Reaction is listed in pH values, which indicate the degree of acidity or alkalinity of the soil.

The salinity of the soils was estimated according to the electrical conductivity of the soil saturation extract, expressed in millimhos per centimeter. The following defines the relative terms used to rate salinity: *None*—less than 4 millimhos per centimeter; *slight*—4 to 8 millimhos per centimeter; *moderate*—8 to 15 millimhos per centimeter; and *strong*—more than 15 millimhos per centimeter.

The shrink-swell potential indicates how much a soil changes in volume when its moisture content changes. It is estimated primarily on the basis of the amount and kind of clay the soil contains. In general, soils classified as CH and A-7 have a high shrink-swell potential, and soils classified as SP or SM have a low shrink-swell potential. Some soil horizons were not rated in table 5, because they were cemented by materials soluble in alkali or by calcium carbonate.

Engineering interpretations of the soils [2]

Table 6 indicates the suitability of the soils for various engineering uses. It also names the soil features and problems that affect use of the soils in highway and conservation engineering. The information is based on an interpretation of the properties listed in table 5 and on field experience and observations.

[2] RALPH SMITH, engineer, Soil Conservation Service, assisted in preparing this subsection.

properties of the soils

for an estimate, or does not apply]

Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Range in permeability	Available water-holding capacity	Reaction	Salinity	Shrink-swell potential
			Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
90–100	80–100	50–65	0.20–0.80	0.16–0.18	8.8–9.6	15–60	Moderate.
----	----	----	<0.05	----	----	----	
80–100	80–100	25–35	2.50–5.0	0.12–0.14	8.2–8.8	1–8	Low.
[1] 85–95	85–95	15–30	5.0–10.0	0.08–0.10	8.6–9.0	0–2	Low.
----	----	----	<0.05	----	----	----	
[1] 70–90	70–90	2–15	>10.0	0.05–0.07	8.6–9.0	1–5	Low.
100	95–100	35–50	0.8–2.50	0.14–0.17	8.6–9.0	4–8	Low.
[2] 50–100	50–100	35–85	0.20–0.80	0.18–0.20	8.2–9.0	4–10	Moderate.
100	100	70–85	0.20–0.80	0.18–0.20	8.0–8.6	4–8	Moderate.
100	100	70–90	0.20–0.80	0.18–0.20	8.2–9.2	1–8	Moderate.
[2] 50–100	[2] 50–100	35–85	0.20–0.80	0.10–0.20	8.2–9.0	2–10	Moderate.
100	100	70–85	0.20–0.80	0.18–0.20	8.0–8.6	3–8	Moderate.
100	100	85–95	0.20–0.80	0.18–0.20	8.2–9.2	2–10	High.
100	100	95–100	0.05–0.20	0.16–0.18	8.2–8.8	4–15	Very high.
100	100	70–85	0.80–2.50	0.18–0.20	8.6–9.2	4–8	Moderate.
100	[2] 50–100	35–85	0.20–0.80	0.18–0.20	8.2–9.0	1–4	Moderate.
100	100	70–85	0.20–0.80	0.18–0.20	8.2–8.6	0–4	Moderate.
70–95	60–85	25–40	2.50–5.0	0.10–0.12	8.2–9.2	1–6	Low.
45–75	20–40	0–3	>10.0	0.04–0.05	8.2–8.8	1–4	Low.
95–100	95–100	40–60	2.50–5.0	0.14–0.17	8.6–9.6	15–40	Low.
95–100	[3] 60–90	[3] 35–70	0.20–0.80	0.18–0.20	8.6–9.6	15–40	Moderate to low.
100	100	30–55	2.50–5.0	0.14–0.17	8.2–8.8	4–15	Low.
95–100	95–100	65–85	0.80–2.50	0.18–0.20	8.6–9.6	8–15	Moderate.
95–100	[3] 60–90	[3] 35–70	0.20–0.80	0.10–0.20	8.6–9.6	15–40	Moderate to low.
100	100	30–55	2.50–5.0	0.14–0.17	8.2–8.8	4–15	Low.
95–100	95–100	30–45	0.20–0.80	0.16–0.18	8.5–9.0	4–15	Moderate.
----	----	----	<0.05	----	----	----	
95–100	95–100	25–35	2.50–5.0	0.12–0.14	8.4–9.0	8–15	Low.
100	100	75–90	0.20–0.80	0.18–0.20	8.4–9.0	4–15	Moderate.

265-477—68——7

TABLE 5.—*Estimated properties*

Soil and map symbol	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Inches			
Bluewing (BuC).	0–60	Very gravelly coarse sand.	GW or GP	A–1–a
Carrizo (CaC, CbC).	0–60	Very gravelly and cobbly coarse sand.	GW or GP	A–1–a
Clay dune land (Cd). (For properties of the land type Playa in mapping unit Cd, see Playa in this table.)	0–60	Clay	MH or CH	A–7
Cliffdown: (CfA, CfB2, ChA, CkB, CsB).	0–13	Gravelly sandy loam	SM	A–2 or A–1–b
	13–52	Gravelly sandy loam	SM or GM	A–2 or A–1–a
(ClB2).	0–13	Very gravelly sandy loam.	GM	A–1–a
	13–50	Gravelly sandy loam	SM or GM	A–2 or A–1–a
Crystal Springs (CmC, CnB, CsB). (For properties of the Cliffdown soil in mapping unit CsB, see the Cliffdown series.)	0–22	Cobbly fine sandy loam	SM	A–2 or A–4
	22–42	Hardpan		
Fang: (FaA, FaB, FgA, FhB, FlA, FmA, FnA, FpA, FsB.) (For properties of the Nyala soil in mapping unit FsB, see the Nyala series.)	0–39	Fine sandy loam	SM	A–2 or A–4
	39–64	Gravelly sandy loam	SM	A–2
(FrB).	0–40	Sandy loam	SM	A–2 or A–4
	40	Hardpan		
Geer: (Ge, Gf).	0–12	Fine sandy loam	SM	A–4
	12–60	Very fine sandy loam	ML	A–4
(Gh).	0–12	Fine sandy loam	SM	A–4
	12–60	Very fine sandy loam	ML	A–4
(Gk).	0–14	Silt loam	ML	A–4
	14–60	Very fine sandy loam	ML	A–4
(Gl, Gm, Gn).	0–14	Silt loam	ML	A–4
	14–60	Very fine sandy loam	ML	A–4
Jarboe (Ja, Jb).	0–6	Sandy loam	SM	A–4 or A–2
	6–13	Silty clay loam	CL or MH	A–7 or A–6
	13–23	Hardpan		
	23–66	Silt loam	ML or CL	A–4
Kawich: (Kp). (For properties of the land type Playa in mapping unit Kp, see Playa in this table.)	0–46	Fine sand	SP	A–3
	46–48	Silty clay loam	CL or CH	A–6 or A–7
(Tud). (Properties are for Kawich soil only; properties of Tufa rock land were not estimated.)	0–50	Fine sand	SP	A–3
	50	Bedrock		
Koyen (KsB, KtB). (For properties of the Tickapoo soil in mapping unit KtB, see the Tickapoo series in this table.)	0–17	Sandy loam	SM	A–4
	17–63	Gravelly sandy loam	SM	A–2 or A–4
Lahontan: (LaA, LaB).	0–12	Fine sandy loam	SM or ML	A–4
	12–62	Silty clay loam	CL or CH	A–6 or A–7
(LhA, LhB, LmA).	0–62	Silty clay loam	CL or CH	A–6 or A–7
(Ln).	0–36	Silty clay	CH or CL	A–7 or A–6
Leo (LrC, LsC, TlC, TnC).	0–16	Gravelly sandy loam	SM	A–2 or A–4
	16–40	Very gravelly loamy sand.	GM	A–1–a
Maynard Lake (MkC, MlB, MlC).	0–60	Gravelly loamy sand	SM	A–1–b

See footnotes at end of table.

of the soils—Continued

Percentage passing sieve— No. 4 (4.7 mm.)	Percentage passing sieve— No. 10 (2.0 mm.)	Percentage passing sieve— No. 200 (0.074 mm.)	Range in permeability	Available water-holding capacity	Reaction	Salinity	Shrink-swell potential
			Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
[1] 30–50	20–50	0–3	>10. 0	0. 04–0. 05	8. 2–8. 6	0–4	Low.
[1] 30–50	10–40	0–3	>10. 0	0. 04–0. 05	8. 2–8. 6	0–4	Low.
100	100	95–100	0. 05–0. 20	0. 16–0. 18	8. 8–9. 6	8–60	High.
70–100	65–95	20–35	2. 50–5. 0	0. 10–0. 12	8. 2–8. 7	1–3	Low.
50–85	50–75	10–35	2. 50–5. 0	0. 09–0. 12	8. 4–8. 8	2–6	Low.
35–50	20–40	5–15	2. 50–5. 0	0. 05–0. 07	8. 2–8. 7	1. 0–3. 0	Low.
50–75	50–75	10–35	2. 50–5. 0	0. 09–0. 12	8. 4–8. 8	2. 0–6. 0	Low.
[1] 70–85	50–80	30–45	0. 80–2. 50	0. 12–0. 14	8. 2–8. 9	1. 0–15. 0	Low.
			<0. 05				
95–100	85–100	30–45	0. 80–2. 50	0. 14–0. 17	8. 2–9. 0	0. 0–9. 0	Low.
90–100	70–85	25–35	0. 80–2. 50	0. 10–0. 12	8. 4–9. 0	4. 0–20. 0	Low.
90–100	85–100	30–45	0. 80–2. 50	0. 12–0. 14	8. 5–9. 0	2. 0–6. 0	Low.
			<0. 05				
95–100	95–100	35–50	2. 50–5. 0	0. 14–0. 17	8. 4–8. 8	0. 0–4. 0	Low.
100	95–100	70–85	0. 80–2. 50	0. 16–0. 18	8. 4–9. 0	3. 0–35. 0	Low.
95–100	95–100	35–50	2. 50–5. 0	0. 14–0. 17	8. 6–9. 6	15. 0–50. 0	Low.
100	95–100	70–85	0. 80–2. 50	0. 16–0. 18	8. 6–9. 6	4. 0–50. 0	Low.
100	95–100	60–85	0. 80–2. 50	0. 18–0. 20	8. 2–8. 8	0. 0–4. 0	Low.
100	95–100	70–85	0. 80–2. 50	0. 16–0. 18	8. 2–9. 0	2. 0–35. 0	Low.
100	95–100	60–85	0. 80–2. 50	0. 18–0. 20	8. 4–9. 0	4. 0–15. 0	Low.
100	95–100	70–85	0. 80–2. 50	0. 16–0. 18	8. 4–9. 0	2. 0–40. 0	Low.
100	95–100	30–50	2. 50–5. 0	0. 12–0. 14	8. 8–9. 6	4. 0–9. 0	Low.
100	95–100	85–100	0. 20–0. 80	0. 18–0. 20	8. 6–9. 0	8. 0–15. 0	High.
			<0. 05				
100	100	85–100	0. 20–0. 80	0. 18–0. 20	8. 8–9. 6	8. 0–25. 0	Moderate.
100	100	5–10	5. 0–10. 0	0 05–0. 07	8. 2–8. 5	0. 0–5. 0	Low.
100	100	85–95	0. 20–0. 80	0. 18–0. 80	8. 6–9. 6	8. 0–60. 0	Flow.
100	100	5–10	5. 0–10. 0	0. 05–0. 07	8. 2–9. 0	0. 0–10. 0	Low.
			<0. 05				
85–95	85–95	35–50	2. 50–5. 0	0. 12–0. 14	8. 2–8. 6	0. 0–3. 0	Low.
70–85	60–80	20–40	2. 50–5. 0	0. 10–0. 12	8. 4–9. 0	2. 0–25. 0	Low.
95–100	95–100	40–55	0. 80–2. 50	0. 14–0. 17	8. 6–9. 0	4. 0–8. 0	Low.
100	100	85–95	0. 05–0. 20	0. 18–0. 20	8. 2–9. 0	2. 0–15. 0	High.
100	95–100	85–95	0. 05–0. 20	0. 18–0. 20	8. 6–9. 6	2. 0–25. 0	High.
100	100	85–95	<0. 05	0. 16–0. 18	8. 6–9. 6	4. 0–50. 0	Very high.
[1] 70–85	60–80	25–40	2. 50–5. 0	0. 10–0. 12	8. 4–8. 8	0. 0–4. 0	Low.
[1] 55–65	30–50	5–15	5. 0–10. 0	0. 05–0. 06	8. 4–8. 8	2. 0–8. 0	Low.
75–90	70–80	10–20	5. 0–10. 0	0. 06–0. 07	8. 2–8. 9	0. 0–8. 0	Low.

TABLE 5.—*Estimated properties*

Soil and map symbol	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Inches			
McCutchen (Mn).	0–16	Loam	CL	A–4
	16–36	Sandy loam	SM	A–2 or A–4
	36–60	Loamy sand	SM	A–1–b or A–2
Monte Cristo (Mr).	0–15	Sandy clay loam	CL or SC	A–6
	15–30	Hardpan		
	30–55	Gravelly loamy sand	SM	A–1–b
Nevoyer (NeD).	0–17	Gravelly loam	GM or SM	A–4
	17	Bedrock		
Nyala (FsB).	0–12	Sandy loam	SM	A–2 or A–4
	12–22	Sandy clay loam	SC or CL	A–6
	22–42	Sandy loam	SM or GM	A–2
	42–72	Loamy sand	SM or GM	A–1–b or A–1–a
Pahranagat (Pa, Pb, Pc, Pd, Pe, Pg, Ph, Pk). (For properties of the Ash Springs soil in mapping units Pe, Pg, Ph, and Pk, see the Ash Springs series in this table.)	0–15	Silt loam	OL or ML	A–4
	15–48	Silty clay loam	MH or CL	A–7 or A–6
Pahroc (PlC).	0–12	Gravelly loam	GM	A–4 or A–2
	12–32	Hardpan		
	32–60	Very gravelly coarse sandy loam.	GM	A–1–a
Papoose:				
(PmA).	0–7	Loamy fine sand	SM	A–2
	7–26	Sandy clay loam	SM or CL	A–4
	26–60	Very gravelly coarse sand.	GP	A–1–a
(PnA, PnA2, PnB).	0–26	Sandy loam	SM or CL	A–4
	26–60	Very gravelly coarse sand.	GP	A–1–a
(PoA).	0–36	Sandy loam	SM or GM	A–4
	36–60	Silty clay loam	CL or MH	A–7
Peat (Pp).	0–60	Peat	Pt	
Penoyer (Pr, Ps, Pt, Pu).	0–60	Silt loam	ML	A–4
Pintwater (PvE).	0–20	Very stony fine sandy loam.	SM	A–2 or A–4
	20	Bedrock		
Playa (Cd, Kp).	0–60	Silty clay	MH or CH	A–7
Puddle (Pw).	0–13	Fine sandy loam	SM	A–4
	13–60	Very fine sandy loam	ML	A–4
Rock land (Rl). (Properties not estimated.)				
Seaman:				
(SaA, ScA, ScB).	0–60	Fine sandy loam	SM	A–4
(SbA).	0–12	Loamy fine sand	SM	A–2
	12–60	Fine sandy loam	SM	A–4
(SdA, SeA).	0–60	Fine sandy loam	SM	A–4
Sierocliff (SfC).	0–22	Very gravelly fine sandy loam.	GM	A–1–a or A–2
	22–33	Hardpan		
	33–43	Very gravelly loamy sand	GM	A–1–a

See footnotes at end of table.

of the soils—Continued

Percentage passing sieve—			Range in permeability	Available water-holding capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)					
			Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
85–100	85–95	55–70	0.8–2.50	0.16–0.18	8.8–9.6	4.0–15.0	Moderate
85–100	75–95	25–50	0.05–0.20	0.12–0.14	8.8–9.6	8.0–50.0	Low.
85–100	80–95	15–30	2.50–5.0	0.08–0.10	8.6–9.2	2.0–15.0	Low.
90–100	85–95	40–70	0.20–0.80	0.16–0.18	8.6–9.4	4.0–20.0	Moderate.
			<0.05				
75–85	60–75	10–15	2.50–5.0	0.06–0.07	8.2–8.8	2.0–8.0	Low.
[1] 75–85	60–80	35–50	0.80–2.50	0.14–0.17	8.0–8.8	0.0–5.0	Low.
			<0.05				
85–95	85–95	30–40	0.80–2.50	0.12–0.14	8.4–9.0	1.0–6.0	Low.
85–95	80–90	40–55	0.20–0.80	0.16–0.18	8.6–9.4	4.0–10.0	Moderate.
65–95	[3] 40–90	[3] 20–35	0.20–0.80	0.12–0.14	8.8–9.6	8.0–25.0	Low.
50–90	[3] 30–85	[3] 5–25	5.0–10.0	0.08–0.10	8.8–9.6	2.0–10.0	Low.
100	100	80–100	0.80–2.50	0.18–0.20	8.1–9.0	8.1–8.0	Moderate.
100	100	85–100	0.20–0.80	0.18–0.20	8.2–9.6	3.0–25.0	High.
60–70	50–60	30–45	0.80–2.50	0.14–0.17	8.2–8.8	0.0–8.0	Low.
			<0.05				
30–40	20–30	5–15	0.80–2.50	0.05–0.07	8.2–8.6	4.0–25.0	Low.
95–100	90–100	25–35	2.50–5.0	0.08–0.10	7.8–8.2	0.0–2.0	Low.
95–100	90–100	40–60	0.20–0.80	0.16–0.18	8.2–8.8	2.0–6.0	Moderate.
80–95	30–50	0–5	5.0–10.0	0.04–0.05	8.2–8.8	2.0–8.0	Low.
95–100	90–100	35–55	0.20–0.80	0.12–0.14	8.2–8.8	1.0–6.0	Moderate.
80–95	30–50	0–5	5.0–10.0	0.04–0.05	8.2–8.8	2.0–8.0	Low.
85–95	80–90	35–50	0.20–0.80	0.12–0.14	8.6–9.4	4.0–15.0	Low to moderate.
100	100	85–100	0.20–0.80	0.18–0.20	8.6–9.4	6.0–25.0	High.
			0.80–2.50	0.25–0.30	8.5–9.0	3.0–8.0	High.
100	100	85–95	0.20–0.80	0.18–0.20	8.2–9.6	2.0–25.0	Low.
[1] 60–90	[1] 60–75	25–40	0.80–2.50	0.06–0.08	8.2–8.9	0.0–6.0	Low.
			<0.05				
100	100	95–100	<0.05	0.06–0.18	9.1–9.6	2.0–50.0	High.
95–100	95–100	35–50	2.50–5.0	0.14–0.17	8.5–9.0	4.0–12.0	Low.
90–100	70–100	50–80	0.20–0.80	0.16–0.18	8.6–9.6	8.0–50.0	Low.
95–100	90–100	35–50	2.50–5.0	0.14–0.17	8.2–8.8	1.0–12.0	Low.
100	100	25–35	5.0–10.0	0.08–0.10	8.2–8.6	0.0–3.0	Low.
95–100	95–100	35–50	2.50–5.0	0.14–0.17	8.2–8.8	2.0–8.0	Low.
90–100	90–100	35–50	2.50–5.0	0.14–0.17	8.4–9.4	4.0–40.0	Low.
[1] 40–55	30–50	10–20	2.50–5.0	0.05–0.07	8.2–8.8	2.0–10.0	Low.
			<0.05				
[1] 35–55	20–40	3–10	5.0–10.0	0.05–0.06	8.2–9.0	2.0–20.0	Low.

TABLE 5.—*Estimated properties*

Soil and map symbol	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Silent (SgC, ShB, SkD).	0–17	Gravelly clay loam	CL–SC	A–6 or A–4
	17–30	Hardpan		
Silverbow (SlD).	0–13	Very stony clay loam	CL	A–7 or A–6
	13–36	Hardpan		
Slickens (Sm).	0–60	Very fine sand	ML or SP	A–5 or A–3
Specter (SnC2).	0–30	Very gravelly sandy loam	GM	A–2
	30–51	Hardpan		
	51–60	Gravelly sandy loam	SM	A–1–b
Stumble:				
(St).	0–50	Gravelly loamy sand	SM	A–1–b
(Su).	0–42	Gravelly loamy sand	SM	A–1–b
	42–60	Clay	CL or CH	A–7 or A–6
Sundown:				
(SvA2).	0–47	Loamy fine sand	SM	A–2
	47–52	Sandy clay loam	SM or CL	A–4
(SwA).	0–14	Sandy loam	SM	A–4 or A–2
	14–47	Loamy fine sand	SM	A–2
	47–52	Sandy clay loam	SM or CL	A–4
(SyB2).	0–12	Very gravelly loamy sand.	GM–GP	A–1–a
	12–60	Gravelly loamy fine sand	SM or GM	A–2 or A–1–b
Theriot (TaF).	0–14	Very stony loam	SM	A–4
	14	Bedrock		
Tickapoo (TcA, TdB, TdB2, TkB, TlC, AmB, KtB). (For properties of the Leo soil in mapping unit TlC, see the Leo series in this table.)	0–17	Gravelly sandy clay loam.	SC or CL	A–6 or A–4
	17–64	Very gravelly loamy coarse sand.	GP or GW	A–1–a
Timpahute (TmC, TnC). (For properties of the Leo soil in mapping unit TnC, see the Leo series in this table.)	0–27	Clay loam	CH or CL	A–7
	27–33	Hardpan		
	33–40	Very gravelly coarse sand.	GP or GW	A–1–a
Timper (Tp).	0–10	Sandy loam	SM	A–4 or A–2
	10–36	Hardpan		
	36–60	Gravelly loamy coarse sand.	SM or GM	A–1–b or A–1–a
Tippipah (Tr).	0–8	Sandy loam	SM	A–4 or A–2
	8–28	Gravelly sandy clay loam	SC or SM	A–6 or A–2
	28–65	Very gravelly coarse sand	GP or GW	A–1–a
Tolicha (TsD).	0–12	Stony fine sandy loam	SM or GM	A–2 or A–1–b
	12	Bedrock		
Tufa rock land (TuD). (Properties of Tufa rock land not estimated. For properites of the Kawich soil in mapping unit TuD, see the Kawich series.)				
Woodrow (Wc).	0–70	Silty clay loam	CL or CH	A–6 or A–7

[1] Stones and cobblestones were removed before sieving.
[2] As much as 50 percent of horizon consisted of lime nodules (concretions) of gravel size.

of the soils—Continued

Percentage passing sieve— No. 4 (4.7 mm.)	Percentage passing sieve— No. 10 (2.0 mm.)	Percentage passing sieve— No. 200 (0.074 mm.)	Range in permeability	Available water-holding capacity	Reaction	Salinity	Shrink-swell potential
			Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
75–90	70–80	45–55	0.20–0.80	0.16–0.18	8.2–9.0	1.0–15.0	Moderate.
----	----	----	<0.05	----	----	----	
[1] 80–90	75–90	55–70	0.20–0.80	0.10–0.12	7.8–9.0	0.0–12.0	Moderate.
----	----	----	<0.05	----	----	----	
100	100	5–95	2.50–5.0	0.08–0.10	8.8–9.0	0.0–4.0	Low.
50–70	40–50	15–25	2.50–5.0	0.05–0.07	8.4–9.4	1.0–20.0	Low.
----	----	----	<0.05	----	----	----	
80–90	70–85	15–25	5.0–10.0	0.06–0.08	7.8–8.5	1.0–6.0	Low.
85–95	75–85	15–25	5.0–10.0	0.06–0.08	8.2–8.8	0.0–5.0	Low.
85–95	75–85	15–25	5.0–10.0	0.06–0.08	8.6–9.0	1.0–8.0	Low.
85–100	85–95	50–65	0.05–0.20	0.16–0.18	8.6–9.2	5.0–25.0	Very high.
90–100	85–95	25–35	5.0–10.0	0.08–0.10	8.4–9.3	0.0–8.0	Low.
100	100	40–60	0.80–2.50	0.16–0.18	8.6–9.6	4.0–25.0	Moderate.
90–100	85–95	30–50	2.50–5.0	0.12–0.14	8.2–8.8	0.0–3.0	Low.
90–100	80–95	25–35	5.0–10.0	0.08–0.10	8.4–9.3	2.0–8.0	Low.
100	100	40–60	0.8–2.50	0.16–0.18	8.6–9.6	4.0–25.0	Moderate.
50–60	25–40	5–15	5.0–10.0	0.05–0.07	8.2–8.8	0.0–2.0	Low.
70–90	60–85	20–35	5.0–10.0	0.06–0.08	8.6–9.2	2.0–8.0	Low.
[1] 60–80	[1] 60–75	35–50	0.80–2.50	0.08–0.10	8.2–8.8	0.0–8.0	Low.
----	----	----	<0.05	----	----	----	
85–100	[3] 70–80	[3] 40–55	0.05–0.20	0.14–0.16	8.3–9.2	1.0–15.0	Moderate to high.
40–60	[3] 25–50	0–6	0.05–0.20	0.05–0.07	8.4–9.2	4.0–15.0	Low.
[1] 90–100	80–90	50–70	0.05–0.20	0.18–0.20	8.2–8.9	0.0–15.0	High.
----	----	----	<0.05	----	----	----	
40–60	25–50	0–6	>10.0	0.04–0.06	8.5–9.0	2.0–10.0	Low.
85–95	75–95	30–50	2.50–5.0	0.12–0.14	8.4–9.0	0.0–12.0	Low.
----	----	----	<0.05	----	----	----	
70–85	55–70	10–20	5.0–10.0	0.06–0.08	7.8–8.5	2.0–10.0	Low.
90–100	85–95	30–50	2.50–5.0	0.12–0.14	8.4–8.9	0.0–6.0	Low.
85–95	70–85	25–40	0.20–0.80	0.14–0.16	8.8–9.4	4.0–15.0	Moderate.
45–60	[3] 15–50	[3] 0–5	0.8–2.50	0.06–0.08	8.2–8.8	2.0–15.0	Low.
[1] 60–80	55–70	20–35	0.80–2.50	0.12–0.14	8.4–9.2	0.0–10.0	Low.
----	----	----	<0.05	----	----	----	
100	100	85–95	0.20–0.80	0.18–0.20	8.8–9.6	8.0–60.0	High.

[3] Horizon contained gravel and sand consisting of silica-cemented aggregates.

TABLE 6.—*Engineering*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]—		Suitability of the soil as source of—		Corrosion potential
			Road subgrade	Road subbase	Sand	Gravel	
	Inches						
Adaven (Ad).	0 to 24	High	Poor to fair	Unsuited.	Unsuited	Unsuited	Very high
	24 to 39						
	39 to 60	Moderate	Fair	Poor to fair.			
Alko (AkB, AlB, AmB). (For interpretations of Tickapoo soil in mapping unit AmB, see the Tickapoo series in this table.)	0 to 11	Low to moderate.	Fair to good.	Fair to good.	Fair to good.	Unsuited	High
	11 to 33						
	33 to 50	Low	Fair to good.	Fair.			
Ash Springs: (An).	0 to 18	High	Fair	Poor to fair.	Unsuited	Unsuited	Very high
	18 to 33	Very high	Poor to fair.	Unsuited.			
	33 to 43	Very high	Poor to fair.	Unsuited.			
(Ap).	0 to 24	Very high	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
	24 to 33	Very high	Poor to fair.	Unsuited.			
	33 to 43	Very high	Poor to fair.	Unsuited.			
(Ao, Ar, As, Pe).	0 to 24	Very high	Poor to fair	Unsuited.	Unsuited	Unsuited	Very high
	24 to 33	Very high	Poor to fair	Unsuited.			
	33 to 43	Very high	Poor to fair	Unsuited.			
(Pg).	0 to 24	Very high	Poor	Unsuited.	Unsuited	Unsuited	Very high
	24 to 33	Very high	Poor to fair	Unsuited.			
	33 to 43	High	Poor	Unsuited.			
(At, Pk).	0 to 20	Very high	Poor to fair	Unsuited.	Unsuited	Unsuited	Very high
	20 to 60	Moderate	Poor to fair	Unsuited.			
(Au, Av, Ph).	0 to 20	Very high	Poor to fair	Unsuited.	Unsuited	Unsuited	Very high
	20 to 60	Moderate	Poor to fair	Unsuited.			

See footnotes at end of table.

interpretations of soils

Degree of limitation for septic tank fields	Soil features affecting—					
	Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Severe	Somewhat poorly drained; water table fluctuates between depths of 18 and 30 inches; very slow permeability.	Average intake rate moderate; available water capacity 4 to 5 inches; contour flooding or controlled flooding is suggested.	Water table at depth of 18 to 30 inches; hardpan at depth of 24 to 36 inches.	Nearly level; very slow permeability because of hardpan.	Strong salt content; very low bearing capacity.	Fair workability; fair to good compaction; very slow permeability when compacted.
Severe	Not applicable	Not applicable	Very dense hardpan at depth of 10 to 20 inches.	Nearly level; very slow permeability because of hardpan.	Bearing capacity high in subsoil and moderate in substratum.	Materials limited because of shallow hardpan.
Severe	Somewhat poorly drained; water table fluctuates between depths of 36 to 54 inches; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Water table fluctuates between depths of 36 and 54 inches and is highest in winter.	Nearly level slopes; moderately slow permeability.	Low bearing capacity.	Fair workability; good to poor compaction; moderate to very slow permeability when compacted.
Severe	Somewhat poorly drained; water table fluctuates between depths of 36 and 54 inches; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Water table fluctuates between depths of 36 and 54 inches and is highest in winter.	Nearly level; moderately slow permeability.	Low bearing capacity.	Fair workability; good to poor compaction; moderate to very slow permeability when compacted.
Severe	Poorly drained; water table fluctuates between depths of 18 to 36 inches; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Water table fluctuates between depths of 18 and 36 inches and is highest in winter.	Nearly level; moderately slow permeability.	Low bearing capacity.	Fair workability; good to poor compaction; moderate to very slow permeability when compacted.
Severe	Very poorly drained; water table fluctuates between depths of 10 and 14 inches; moderately slow permeability.	Average intake rate moderate; available water capacity more than 10 inches; contour flooding or controlled flooding is suggested.	Water table fluctuates between depths of 10 and 14 inches.	Nearly level; moderately slow permeability.	Very low bearing capacity.	Fair workability; good to poor compaction; moderate to very slow permeability when compacted; material in substratum unsuited.
Severe	Somewhat poorly drained; water table fluctuates between depths of 36 and 60 inches; slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Water table fluctuates between depths of 36 and 60 inches; subsoil very sticky when wet.	Nearly level; slow permeability.	Bearing capacity low in upper part, very low below.	Fair to poor workability; good to poor compaction; very slow permeability when compacted.
Severe	Poorly drained; water table fluctuates between depths of 10 and 36 inches; slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Water table fluctuates between depths of 10 and 36 inches; subsoil very sticky when wet.	Nearly level; slow permeability.	Bearing capacity low in upper part, very low below.	Fair to poor workability; good to poor compaction; very slow permeability when compacted.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]—		Suitability of the soil as source of—		Corrosion potential
			Road subgrade	Road subbase	Sand	Gravel	
	Inches						
Aysees (AyA, AyB).	0 to 22	Moderate	Fair	Poor to fair.	Fair to good.	Fair to good.	High
	22 to 60	Low	Excellent	Excellent.			
Bastian: (Ba).	0 to 12	High	Fair to poor	Poor.	Unsuited	Unsuited	Very high
	12 to 50	Very high	Poor to fair	Unsuited.			
	50 to 60	High	Fair	Poor to fair.			
(Bc, Bd).	0 to 16	Very high	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
	16 to 50	Very high	Poor to fair.	Unsuited.			
	50 to 60	High	Fair	Poor to fair.			
Belted(Bs).	0 to 7	Moderate	Fair	Poor to fair.	Unsuited	Unsuited	Very high
	7 to 11						
	11 to 32	Moderate	Fair to good.	Fair to good.			
	32 to 60	Very high	Poor to fair.	Unsuited.			
Bluewing(BuC).	0 to 10	Low	Good to excellent.	Good.	Fair	Good	Moderate
	10 to 60	None	Excellent	Excellent.			
Carrizo(CaC, CbC).	0 to 6	Low	Fair to good.	Fair.	Fair	Good	Moderate
	6 to 60	None	Excellent	Excellent.			
Clay dune land(Cd). (For interpretations of the land type Playa in mapping unit Cd, see Playa in this table.)	0 to 60	High	Poor	Unsuited.	Unsuited	Unsuited	Very high

See footnotes at end of table.

of soils—Continued

Degree of limitation for septic tank fields	Soil features affecting—					
	Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Slight	Well drained or somewhat excessively drained; very rapid permeability in substratum.	Average intake rate moderate; available water capacity 4 to 5 inches; border or corrugation irrigation is suggested, depending on slope.	Sloughing may occur because of loose, very gravelly substratum.	Slopes greater than 1 percent in most areas; very rapid permeability in substratum.	When soil is wet, bearing capacity moderate in upper part, very low below.	Fair to good workability; good compaction with close controls; rapid permeability in subsoil when compacted.
Severe	Somewhat poorly drained; water table fluctuates between depths of 48 and 60 inches; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Subsoil weakly cemented with silica, easily excavated only when moist.	Nearly level; moderately slow permeability.	Moderate and strong salt content; low or very low bearing capacity in substratum when wet.	Fair workability; good to poor compaction with close controls; moderate to very slow permeability when compacted.
Severe	Somewhat poorly drained; water table fluctuates between depths of 36 and 60 inches; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Subsoil weakly cemented with silica, easily excavated only when moist.	Nearly level; moderately slow permeability.	Moderate and strong salt content; low or very low bearing capacity in substratum when wet.	Fair workability; good to poor compaction with close controls; moderate to very slow permeability when compacted.
Severe	Not applicable	Not applicable	Strongly cemented subsoil over very hard and hard substratum.	Nearly level; very slow permeability.	Moderate and very low bearing capacity in substratum when wet.	Materials limited because of shallow hardpan.
Slight	Not applicable	Not applicable	Very gravelly to depth of 0 to 10 inches; very gravelly and cobbly below that depth.	Nearly level to strongly sloping; very rapid permeability.	High bearing capacity when wet.	Good workability; good compaction; rapid permeability when compacted.
Slight	Not applicable	Not applicable	Surface layer gravelly or stony; very gravelly, cobbly, and loose below depth of 6 inches.	Nearly level to strongly sloping; very rapid permeability.	High bearing capacity when wet.	Good workability and compaction; rapid permeability when compacted.
Severe	Not applicable	Not applicable	Exposed to excavation without trenching.	Isolated mounds on playa; 3 to 12 feet high, with almost vertical slopes.	Very low bearing capacity when wet.	Poor workability; fair to poor compaction.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]— Road subgrade	Suitability as source of [1]— Road subbase	Suitability of the soil as source of— Sand	Suitability of the soil as source of— Gravel	Corrosion potential
	Inches						
Cliffdown: (CfA, CfB2, ChA, CkB, CsB).	0 to 13	Moderate	Fair	Poor to fair.	Fair	Fair	High
	13 to 52	Moderate	Fair to good.	Fair.			
(ClB2).	0 to 13	Moderate	Fair to good.	Fair.	Fair	Fair	High
	13 to 52	Moderate	Fair to good.	Fair.			
Crystal Springs (CmC, CnB, CsB). (For interpretations of Cliffdown soil in mapping unit CsB, see the Cliffdown series in this table.)	0 to 22	High	Fair	Poor to fair.	Unsuited	Poor	Very high
	22 to 42						
Fang: (FaA, FaB, FgA, FhB, FlA, FmA, FnA, FpA, FsB). (For interpretations of Nyala soil in mapping unit FsB, see the Nyala series in this table.)	0 to 64	High	Fair	Poor to fair.	Poor	Unsuited	Very high
(FrB).	0 to 40	High	Fair	Poor to fair.	Poor	Unsuited	Very high
	40						
Geer: (Ge, Gf).	0 to 12	High	Fair	Poor to fair.	Unsuited	Unsuited	Very high
	12 to 60	Very high	Poor to fair.	Unsuited			
(Gk).	0 to 60	Very high	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high

See footnotes at end of table.

of soils—Continued

Degree of limitation for septic tank fields	Soil features affecting—					
	Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Slight	Well drained; moderately rapid permeability.	Average intake rate rapid; available water capacity 4 to 5 inches; border or corrugation irrigation is suggested method, depending on slope.	Easy to excavate, but gravel content increases with depth.	Nearly level or gently sloping; moderately rapid permeability.	Moderate or, in some places, high bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to slow permeability when compacted.
Slight	Not applicable	Not applicable	Easy to excavate, but contains gravel in profile.	Nearly level or gently sloping; moderately rapid permeability.	Moderate or, in some places, high bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to slow permeability when compacted.
Severe	Not applicable	Not applicable	Very dense hardpan at depth of 11 to 24 inches.	Gently sloping to moderately sloping; very slow permeability.	High bearing capacity when wet.	Materials limited because of hardpan.
Slight to moderate.	Well drained; moderate permeability.	Average intake rate moderate (rapid in FlA and FmA); available water capacity 8 to 10 inches; border or corrugation irrigation is suggested method, depending on slope.	Easy to excavate	Slopes mostly 1 to 3 percent; moderate permeability.	Low bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Severe	Well drained; permeability moderate to depth of 40 inches, very slow below that depth.	Average intake rate moderate; available water capacity 7 to 8 inches; corrugation irrigation is suggested.	Easy to excavate, but indurated hardpan occurs below depth of 40 inches.	Gently sloping; very slow permeability.	Low bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Moderate to slight.	Moderately well drained; water table is at depth of 7 to 10 feet; moderate permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Easy to excavate	Nearly level; moderate permeability.	Low and very low bearing capacity when wet.	Fair workability and good to poor compaction with close controls; moderate to very slow permeability when compacted.
Moderate to slight.	Moderately well drained; water table at depth of 7 to 10 feet; moderate permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Easy to excavate	Nearly level; moderate permeability.	Very low bearing capacity.	Fair workability and good to poor compaction with close controls; moderate to very slow permeability when compacted.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]— Road subgrade	Road subbase	Suitability of the soil as source of— Sand	Gravel	Corrosion potential
	Inches						
Geer—Continued (Gh, Gl, Gm, Gn).	0 to 60	High	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
Jarboe (Ja, Jb).	0 to 13	High	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
	13 to 23						
	23 to 60	Very high	Poor	Unsuited.			
Kawich (Kp, TuD). (For interpretations of the land type Playa in mapping unit Kp, see Playa in this table. Interpretations of Tufa rock land in the unit TuD were not made.)	0 to 46	Low to none.	Fair to good.	Fair.	Fair	Unsuited	High
	46 to 48	High	Poor	Unsuited.			
Koyen (KsB, KtB). (For interpretations of Tickapoo soil in mapping unit KtB, see the Tickapoo series in this table.)	0 to 17	High	Fair	Poor to fair.	Unsuited	Unsuited	Very high
	17 to 63	Moderate	Fair	Poor to fair.			
Lahontan: (LaA, LaB, LhA, LhB, LmA).	0 to 12	High	Poor to fair	Unsuited.	Unsuited	Unsuited	Very high
	12 to 62	High	Poor to fair	Unsuited.			
(Ln).	0 to 36	Moderate to high.	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
Leo (LrC, LsC, TlC, TnC).	0 to 16	High	Fair	Poor to fair.	Fair to poor.	Fair to good.	High
	16 to 54	Low	Excellent to good.	Good.			

See footnotes at end of table.

of soils—Continued

Degree of limitation for septic tank fields	Soil features affecting— Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Severe	Somewhat poorly drained; water table is at depth of 36 to 60 inches because of excessive seepage.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Easy to excavate; water table at depth of 36 to 60 inches, highest in winter.	Nearly level; moderate permeability.	Low or very low bearing capacity when wet; salt content none to strong.	Fair workability and good to poor compaction with close controls; moderate to very slow permeability when compacted.
Severe	Not applicable	Not applicable	Strongly cemented hardpan at depth of 10 to 20 inches; very hard silty material below.	Slightly concave, nearly level basins near valley floor; very slow permeability.	Moderate and very low bearing capacity when wet; slight to strong salt content.	Materials limited because of hardpan.
Moderate	Not applicable	Not applicable	Very easy to excavate, but sloughing may be a problem.	Nearly level to strongly sloping dunes; rapid permeability.	Moderate bearing capacity when wet.	Fair workability and good compaction; moderate to rapid permeability when compacted.
Slight	Well drained; moderately rapid permeability.	Average intake rate moderate; available water capacity 6 to 7.5 inches; corrugation irrigation is suggested.	Easy to excavate but is more sandy and gravelly with increasing depth.	Gently sloping; moderate permeability.	Low bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Severe	Somewhat poorly drained; water table at depth of 30 to 42 inches; slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border or corrugation irrigation is suggested method, depending on slope.	Subsoil very sticky when wet; water table at depth of 30 to 42 inches.	Nearly level and gently sloping; slow permeability.	Moderate to low bearing capacity when wet.	Fair workability and fair to good compaction with close controls; moderate to very slow permeability when compacted.
Severe	Poorly drained; water table fluctuates between depths of 18 and 30 inches; very slow permeability.	Average intake rate slow; available water capacity 8 to 10 inches; border irrigation or controlled flooding is suggested.	Subsoil very sticky when wet; water table at depth of 18 to 30 inches.	Nearly level; very slow permeability.	Low bearing capacity when wet.	Poor workability and fair to poor compaction.
Slight	Not applicable	Not applicable	Easy to excavate, but gravel and sand content increases with depth; bedrock below depth of 30 inches in LrC.	Gently to strongly sloping; rapid permeability.	Bearing capacity moderate in upper part, high in lower part; bedrock below depth of 30 inches in LrC.	Fair and good workability and good compaction with close controls; moderate to very slow permeability when compacted.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]—		Suitability of the soil as source of—		Corrosion potential
			Road subgrade	Road subbase	Sand	Gravel	
	Inches						
Maynard Lake: (MkC, MlC).	0 to 60	Low	Fair to good.	Fair.	Good	Fair	High
(MlB).	0 to 60	Low	Fair to good.	Fair.	Good	Fair	High
McCutchen (Mn).	0 to 16	High	Poor to fair.	Unsuited.	Poor to fair.	Unsuited	Very high
	16 to 36	Moderate	Fair	Poor to fair.			
	36 to 60	Low	Fair to good.	Fair.			
Monte Cristo (Mr).	0 to 15	High	Poor	Unsuited.	Unsuited	Unsuited	Very high
	15 to 30						
	30 to 55	Slight	Fair to good.	Fair.			
Nevoyer (NeD).	0 to 17	High	Poor	Unsuited.	Unsuited	Poor	High
	17						
Nyala (FsB).	0 to 12	High	Fair	Poor to fair.	Poor to fair.	Unsuited	Very high
	12 to 22	High	Poor to fair.	Poor.			
	22 to 42	Moderate	Fair	Poor to fair.			
	42 to 72	Low	Fair to good.	Fair.			

See footnotes at end of table.

of soils—Continued

Degree of limitation for septic tank fields	Soil features affecting—					
	Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Slight	Not applicable	Not applicable	Easy to excavate, but loose, very gravelly strata may slough.	Moderately to strongly sloping; rapid permeability.	Moderate bearing capacity when wet.	Fair workability and good compaction with close control; moderate to very slow permeability when compacted.
Slight	Somewhat excessively drained; rapid permeability.	Average intake rate rapid; available water capacity 3 to 4 inches; corrugations, contour flooding, or sprinkler irrigation is suggested method, depending on side slopes.	Easy to excavate, but loose, very gravelly strata may slough.	Nearly level to gently sloping; rapid permeability.	Moderate bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Severe	Not applicable	Not applicable	Material in subsoil hard or very hard when dry because of lime impregnation.	Nearly level; slow permeability.	Low to moderate bearing capacity when wet; high salt content in subsoil.	Fair workability and good over fair to good compaction with close controls; moderate to very slow permeability when compacted.
Severe	Not applicable	Not applicable	Hardpan strongly cemented with silica at depth of 15 to 24 inches.	Nearly level; very slow permeability.	Low bearing capacity when wet; high salt content above hardpan.	Materials limited because of hardpan.
Severe	Not applicable	Not applicable	Hard bedrock at depth ranging from a few inches to 20 inches.	Moderately sloping to strongly sloping; in foothills and on ridgetops; moderate permeability.	Moderate bearing capacity when wet.	Materials limited because of bedrock.
Severe	Well drained; permeability moderately slow in subsoil but rapid in substratum.	Average intake rate moderate; available water capacity 6 to 7.5 inches; corrugation irrigation is suggested.	Weakly cemented substratum most easily excavated when moist.	Gently sloping; moderately slow permeability.	Low bearing capacity when wet.	Fair and good workability; good and fair compaction; moderate to very slow permeability when compacted.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]— Road subgrade	Road subbase	Suitability of the soil as source of— Sand	Gravel	Corrosion potential
	Inches						
Pahranagat: (Pa, Pd, Pe, Ph).	0 to 48	Very high to high.	Poor	Unsuited.	Unsuited	Unsuited	Very high
(Pb, Pc, Pk).	0 to 48	Very high to high.	Poor	Unsuited.	Unsuited	Unsuited	Very high
(Pg). (For interpretations of Ash Springs soil in mapping units Pe, Pg, Ph, and Pk, see the Ash Springs series in this table.)	0 to 48	Very high to high.	Poor	Unsuited.	Unsuited	Unsuited	Very high
Pahroc (PlC).	0 to 12 12 to 32 32 to 60	High Slight	Poor to fair Good	Unsuited. Fair.	Poor to fair	Good to fair	Very high
Papoose: (PmA).	0 to 12 12 to 32 32 to 60	Moderate High Low	Fair to good. Fair Good to excellent.	Fair to poor. Poor. Good.	Poor to fair	Unsuited to fair.	High
(PnA, PnA2, PnB).	0 to 26 26 to 60	High Low	Fair Good to excellent.	Poor. Good.	Poor to fair	Unsuited to fair.	High
(PoA).	0 to 36 36 to 60	High High	Fair Poor	Poor. Unsuited.	Poor to unsuited.	Unsuited	Very high

See footnotes at end of table.

of soils—Continued

Degree of limitation for septic tank fields	Soil features affecting—					
	Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Severe	Poorly drained; water table fluctuates between depths of 18 and 36 inches; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Some strata very sticky when wet; water table between depths of 18 and 36 inches, highest during winter.	Nearly level areas on flood plain; moderately slow permeability.	Very low bearing capacity when wet.	Fair to poor workability; good to very poor compaction; moderate to very slow permeability when compacted.
Severe	Somewhat poorly drained; water table fluctuates between depths of 4 and 5 feet; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Some strata very sticky when wet; water table between depths of 4 and 5 feet, highest in winter.	Nearly level areas on flood plain; moderately slow permeability.	Very low bearing capacity when wet.	Fair to poor workability; good to very poor compaction; moderate to very slow permeability when compacted.
Severe	Very poorly drained; water table is at depth of 4 to 6 inches; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; contour flooding or controlled flooding is suggested.	Some strata very sticky when wet; water table at depth of 4 to 6 inches.	Nearly level areas on flood plain; moderately slow permeability.	Very low bearing capacity when wet.	Fair to poor workability; good to very poor compaction; moderate to very slow permeability when compacted.
Severe	Not applicable	Not applicable	Indurated hardpan at depth of 10 to 20 inches, underlain by weakly cemented material.	Gently sloping to moderately sloping; very slow permeability.	Moderate bearing capacity when wet.	Materials limited because of hardpan.
Slight [2]	Well drained; moderate permeability.	Average intake rate rapid; available water capacity 4 to 5 inches; border irrigation is suggested.	Gravel content increases with depth; sloughing may be a problem.	Nearly level; permeability generally moderate, but rapid in underlying material.	When soil is wet, bearing capacity low in upper part, high in lower part.	Fair to good workability and good compaction with close controls; when soil is compacted, permeability moderate to very slow in upper part, rapid in lower part.
Slight [2]	Well drained; moderate permeability.	Average intake rate moderate; available water capacity 4 to 5 inches; border or corrugation irrigation is suggested, the method depending on the slope.	Gravel content increases with depth; sloughing may be a problem.	Nearly level and gently sloping; permeability generally moderate, but rapid in underlying material.	When soil is wet, bearing capacity low in upper part, high in lower part.	Fair to good workability and good compaction with close controls; when soil is compacted, permeability moderate to very slow in upper part, rapid in lower part.
Severe	Well drained; permeability moderate above the substratum and moderately slow in it.	Average intake rate moderate; available water capacity 5 to 6 inches; border irrigation is suggested.	Gravel content increases with depth; sloughing may be a problem; fine-textured, lake-laid material in substratum.	Nearly level; moderately slow permeability.	Low bearing capacity when wet.	Fair to good workability and good compaction with close controls; when soil is compacted, permeability moderate to very slow in upper part, rapid in lower part; better valued materials lacking in substratum.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]—		Suitability of the soil as source of—		Corrosion potential
			Road subgrade	Road subbase	Sand	Gravel	
	Inches						
Peat (Pp).	0 to 60	Low	Unsuited	Unsuited.	Unsuited	Unsuited	Very high
Penoyer (Pr, Ps, Pt, Pu).	0 to 60	Very high	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
Pintwater (PvE).	0 to 20	High	Fair	Poor to fair.	Unsuited	Unsuited	High
	20						
Playa (Cd, Kp).	0 to 60	High	Poor	Unsuited.	Unsuited	Unsuited	Very high
Puddle (Pw).	0 to 13	High	Fair	Poor to fair.	Unsuited	Unsuited	Very high
	13 to 60	Very high	Poor to fair.	Unsuited.			
Rock land (Rl). (Interpretations not made.)							
Seaman: (SaA, ScA, ScB).	0 to 60	High	Fair	Poor to fair.	Poor	Unsuited	High
(SbA).	0 to 12	Moderate	Fair to good.	Fair to good.	Poor	Unsuited	High
	12 to 60	High	Fair	Poor to fair.			
(SdA, SeA).	0 to 60	High	Fair	Poor to fair.	Poor	Unsuited	Very high

See footnotes at end of table.

of soils—Continued

Degree of limitation for septic tank fields	Soil features affecting—					
	Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Severe	Very poorly drained; water table at the surface; moderate permeability.	Not applicable	Easy to excavate, but water table at surface.	Nearly level; moderate permeability.	Must be removed; oxidation results in settling.	Unsuited.
Severe	Well drained; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Easy to excavate	Nearly level; moderately slow permeability.	Very low bearing capacity when wet.	Fair workability and good to poor compaction with close control; moderate to very slow permeability when compacted.
Severe	Not applicable	Not applicable	Bedrock at depth of 10 to 20 inches.	Sloping to very steep on hills and ridges; somewhat excessively drained.	Moderate bearing capacity when wet.	Materials limited because of bedrock.
Severe	Not applicable	Not applicable	Easy to excavate but subject to overflow.	On the flat valley floor; very slow permeability.	Very low bearing capacity when wet.	Poor workability; poor to very poor compaction.
Severe	Well drained; moderately slow permeability.	Average intake rate moderate; available water capacity 8 to 10 inches; border irrigation is suggested.	Material in subsoil hard or very hard because of lime impregnation.	Nearly level; moderately slow permeability.	Bearing capacity low in upper part, very low below.	Fair workability and good to poor compaction; moderate to very slow permeability when compacted.
Slight	Well drained; moderately rapid permeability.	Average intake rate moderate; available water water capacity 6.5 to 7.5 inches; border or corrugation irrigation is suggested, depending on slope.	Easy to excavate	Nearly level and gently sloping; moderately rapid permeability.	Low bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Slight	Well drained; moderately rapid permeability.	Average intake rate rapid; available water capacity 6 to 7 inches; border irrigation is suggested.	Easy to excavate	Nearly level; moderately rapid permeability.	Low bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Severe	Somewhat poorly drained; water table is at depth of 36 to 72 inches because of excessive seepage; moderately rapid permeability.	Average intake rate moderate; available water capacity 6.5 to 7.5 inches; border irrigation is suggested.	Easy to excavate; water table at depth of 36 to 72 inches, highest in winter.	Nearly level; moderately rapid permeability.	Low bearing capacity when wet; salt content slight to strong.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]— Road subgrade	Suitability as source of [1]— Road subbase	Suitability of the soil as source of— Sand	Suitability of the soil as source of— Gravel	Corrosion potential
	Inches						
Sierocliff (SfC).	0 to 22	High	Good	Fair.	Poor	Fair	Very high
	22 to 33						
	33 to 43	Slight	Good to excellent.	Good.			
Silent (SgC, ShB, SkD).	0 to 17	High	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
	17 to 30						
Silverbow (SlD).	0 to 13	High	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
	13 to 36						
Slickens (Sm).	0 to 60	Low to very high.	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
Specter (SnC2).	0 to 30	Moderate	Good	Fair.	Poor	Poor to fair.	Very high
	30 to 51						
	51 to 60	Low	Fair to good.	Fair to good.			
Stumble: (St).	0 to 50	Low	Fair to good.	Fair to good.	Fair to poor.	Poor	Moderate
(Su).	0 to 42	Low	Fair to good.	Fair to good.	Fair to poor.	Poor	Very high
	42 to 60	High	Poor to fair.	Unsuited.			

See footnotes at end of table.

of soils—Continued

Degree of limitation for septic tank fields	Soil features affecting—					
	Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Severe	Not applicable	Not applicable	Dense, indurated hardpan at depth of 20 to 30 inches.	Moderately sloping to strongly sloping; very slow permeability.	Moderate bearing capacity when wet.	Materials limited because of hardpan.
Severe	Not applicable	Not applicable	Dense, indurated hardpan at depth of 15 to 22 inches.	Gently sloping to strongly sloping; very slow permeability.	Moderate bearing capacity when wet.	Materials limited because of hardpan.
Severe	Not applicable	Not applicable	Dense, indurated, very stony hardpan at depth of about 13 inches; underlain by basalt below depth of 30 inches.	Strongly sloping colluvial slopes; very slow permeability.	Low bearing capacity when wet.	Materials limited because of hardpan.
Slight	Not applicable	Not applicable	Easy to excavate, but sloughing may be a problem.	Gently sloping; moderately rapid permeability.	Very low bearing capacity when wet.	Fair workability and good to poor compaction with close controls; moderate to very slow permeability when compacted.
Severe	Not applicable	Not applicable	Dense, indurated hardpan at depth of 24 to 36 inches.	Gently sloping to strongly sloping; very slow permeability.	High bearing capacity when wet.	Materials limited because of hardpan.
Slight	Somewhat excessively drained; rapid permeability.	Average intake rate rapid; available water capacity 3 to 4 inches; border or sprinkler irrigation is suggested.	Easy to excavate, but sloughing may be a problem.	Nearly level; rapid permeability.	Low to moderate bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Severe	Somewhat excessively drained; permeability rapid in upper layers but slow below depth of 36 to 58 inches.	Average intake rate rapid; available water capacity 3.5 to 4.5 inches; border or sprinkler irrigation is suggested.	Easy to excavate, but sloughing may be a problem above depth of 36 to 58 inches.	Nearly level; permeability rapid in upper layers but slow below depth of 36 to 58 inches.	Low to moderate bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]—		Suitability of the soil as source of—		Corrosion potential
			Road subgrade	Road subbase	Sand	Gravel	
	Inches						
Sundown: (SvA2).	0 to 47	Low	Fair to good.	Fair to good.	Poor to unsuited.	Unsuited	Very high
	47 to 52	High	Fair	Poor to fair.			
(SwA).	0 to 47	Moderate	Fair to good.	Fair to good.	Poor to unsuited.	Unsuited	Very high
	47 to 52	High	Fair	Poor to fair.			
(SyB2).	0 to 12	Slight	Good to excellent.	Good.	Fair to poor.	Fair to poor.	Moderate
	12 to 60	Moderate	Fair to good.	Fair.			
Theriot (TaF).	0 to 14	High	Poor to fair.	Unsuited.	Unsuited	Poor	High
	14						
Tickapoo: (TcA, TdB, TdB2, TkB, KtB).	0 to 17	High	Poor to fair.	Unsuited.	Poor to unsuited.	Unsuited	Very high
	17 to 64	Low	Good to excellent.	Good.			
(TlC, AmB, KtB). (For interpretations of Leo soil in mapping unit TlC, see the Leo series in this table.)	0 to 17	High	Poor to fair.	Unsuited.	Poor to unsuited.	Unsuited	Very high
	17 to 64	Low	Good to excellent.	Good.			
Timpahute (TmC, TnC). (For interpretations of Leo soil in mapping unit TnC, see the Leo series in this table.)	0 to 27	Moderate	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high
	27 to 33						
	33 to 60	Low	Good to excellent.	Good.			
Timper (Tp).	0 to 10	High	Fair	Poor to fair.	Unsuited	Unsuited	Very high
	10 to 36						
	36 to 60	Low	Fair to good.	Fair to good.			

See footnotes at end of table.

of soils—Continued

Degree of limitation for septic tank fields	Soil features affecting—					
	Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Moderate	Excessively drained; rapid permeability.	Average intake rate rapid; available water capacity 4 to 5 inches; border or sprinkler irrigation is suggested.	Easy to excavate, but sloughing may be a problem above depth of 47 inches.	Nearly level; rapid permeability to depth of 47 inches.	Low bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Moderate	Excessively drained; rapid permeability.	Average intake rate moderate; available water capacity 5 to 6 inches; border irrigation is suggested.	Easy to excavate, but sloughing may be a problem above depth of 47 inches.	Nearly level; rapid permeability to depth of 47 inches.	Low bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Slight	Not applicable	Not applicable	Easy to excavate, but sloughing may be a problem above depth of 47 inches.	Gently sloping; rapid permeability to depth of 47 inches.	Low bearing capacity when wet.	Fair workability and good compaction with close controls; moderate to very slow permeability when compacted.
Severe	Not applicable	Not applicable	Hard bedrock at depth of 14 inches.	Steep and very steep; on mountainous slopes and rugged ridges.	Low bearing capacity when wet.	Materials limited because of bedrock.
Severe	Well drained; low permeability.	Average intake rate moderate; available water capacity 4 to 5 inches; border or corrugation irrigation is suggested method, depending on slope.	Strongly to weakly cemented hardpan at depth of 15 to 30 inches; gravel content increases with depth.	Nearly level and gently sloping; slow permeability.	Bearing capacity low in upper part, high in lower part.	Fair workability and fair to good compaction with close controls; very slow permeability when compacted.
Severe	Not applicable	Not applicable	Strongly to weakly cemented hardpan at depth of 15 to 30 inches; gravel content increases with depth.	Gently sloping to strongly sloping; slow permeability.	Bearing capacity low in upper part, high in lower part.	Fair workability and fair to good compaction with close controls; very slow permeability when compacted.
Severe	Not applicable	Not applicable	Dense, indurated hardpan at depth of 19 to 29 inches; very sticky clay above.	Gently sloping to strongly sloping; very slow permeability.	Very low bearing capacity when wet.	Materials limited because of hardpan.
Severe	Not applicable	Not applicable	Strongly cemented hardpan at depth of 10 to 20 inches; loose, gravelly and sandy materials below.	Nearly level, very slow permeability.	Low to moderate bearing capacity when wet.	Materials limited because of hardpan.

265-477—68——8

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Depth from surface	Susceptibility to frost action [1]	Suitability as source of [1]—		Suitability of the soil as source of—		Corrosion potential
			Road subgrade	Road subbase	Sand	Gravel	
	Inches						
Tippipah (Tr).	0 to 8	High	Fair	Poor to fair.	Poor	Poor to fair.	Very high
	8 to 28	Moderate	Poor to fair.	Poor.			
	28 to 65	Low	Good to excellent.	Good.			
Tolicha (TsD).	0 to 12	Moderate	Fair	Poor to fair.	Poor	Poor	Very high
	12 to 14	----------	----------	----------			
Tufa rock land (TuD). (Interpretations of Tufa rock land were not made. For interpretations of Kawich soil in mapping unit TuD, see the Kawich series.)							
Woodrow (Wc).	0 to 75	High	Poor to fair.	Unsuited.	Unsuited	Unsuited	Very high

[1] Dashes indicate information does not apply or is not available.

Frost action is the heaving and softening of a soil and is caused by freezing and thawing of water in the soil. The susceptibility of a soil to frost action depends on the texture, the length of time the temperature is below the freezing point, and the depth to the water table during that time. Rated highest in susceptibility are silts and very fine sandy loams in which the water table is high. Rated lowest are coarse-grained materials that contain little or no fines.

The suitability ratings for road subgrade and road subbase are those of soil material not subjected to frost action. In areas where frost heaving is a problem, the susceptible soils should be rated lower than the ratings shown in the table. Generally the best soil material for subgrade and subbase are coarse-grained soils. Soils classified GW or A-1 are rated excellent. The suitability of fine-grained soils for road subgrade ranges from fair to very poor. These fine-grained soils are classified ML, CL, CH, or MH and have an AASHO classification of A-4, A-5, A-6, or A-7. They are not suitable as material for road subbase and road base, because they have one or more adverse properties—moderate to high shrink-swell potential, moderate to high susceptibility to frost action, low stability, low bearing capacity, and slow internal drainage.

Suitability ratings of the soils as a source of gravel and sand are based on laboratory data and on field observations. Soils classified as GW and SW are an excellent source of well-graded gravel and sand. Soils classified as GP and SP contain poorly graded gravel and sand and are rated as a good source. Other soils in which there is less than 50 percent fine to coarse sand or gravel are considered not suitable as a source of these materials.

The corrosion potential of a soil can be correlated with the conductivity of an electric current in the soil. It is determined largely by the nature and amount of soluble salts and by the moisture content. Although it is difficult to correlate the rate of corrosion with a single physical property of the soil, texture is important because of its effect on aeration, moisture-holding capacity, and movement of water. Among the features considered in rating corrosion potential are soil drainage, presence of soluble salts, and frequency of wetting and drying. The rating is *very low* for soils that are well drained, gravelly or stony, moderately coarse textured, steep or very steep, and free of salts. In contrast, the rating is *very high* for soils that are poorly drained or very poorly drained, whether or not the soils are salt free, and it is *very high* for somewhat poorly drained soils having a high content of salts.

The degree of limitation for use of the soils as septic tank fields was estimated after considering the percolation rate in the soil, the depth to a permanently high or

of soils—Continued

Degree of limitation for septic tank fields	Soil features affecting—					
	Agricultural drainage	Irrigation	Excavatability	Reservoir areas	Foundations	Embankments
Severe	Well drained; moderately slow permeability.	Average intake rate moderate; available water capacity 4 to 5 inches; border irrigation is best method suggested.	Substratum weakly cemented, hard to very hard when dry; excavate when moist.	Nearly level; moderately slow permeability.	Bearing capacity low in upper part, high in lower part.	Fair to good workability; fair to good compaction; moderate to very slow permeability when compacted.
Severe	Not applicable	Not applicable	Hard bedrock at depth of 4 to 20 inches.	Moderately sloping to strongly sloping hills; moderate permeability.	Moderate bearing capacity when wet.	Materials limited because of bedrock.
Severe	Well drained; moderately slow permeability.	Average intake rate slow; available water capacity 8 to 10 inches; border irrigation is suggested.	Easy to excavate but sticky when wet.	Nearly level; moderately slow permeability.	Low bearing capacity when wet; high salt content.	Fair workability; fair to good compaction; very slow permeability when compacted.

[2] Rating is for soil having a leach line in the substratum.

a seasonally high water table, the depth to bedrock, the presence of a hardpan or a clay layer, and slope.

The limitation is *slight* for sandy or loamy, well-drained to excessively drained soils that have slopes of less than 12 percent and that do not contain a subsurface layer restricting the movement of water. In these soils the percolation rate generally is 1 inch in 45 minutes or less. In some soils with only a slight limitation, the percolation rate, to a depth of about 3 feet, is slower than 1 inch in 45 minutes, but it increases below that depth. Because some of the soils are porous and transmit effluent rapidly, nearby wells, springs, or ponds may be contaminated by seepage of waste liquid.

The limitation is *moderate* for loamy or gravelly or gravelly loamy, somewhat poorly drained to well-drained soils having slopes of less than 12 percent. These soils are seasonally wet, have a fluctuating water table that rises to within 4 to 6 feet of the surface late in spring and in summer, or have a percolation rate of 1 inch in 45 to 75 minutes, or they have a combination of these adverse features.

The limitation is *severe* for somewhat poorly drained to very poorly drained soils in which the water table is within 5 feet of the surface most of the year and usually ranges between the surface and a depth of 3 feet in winter. Generally, these soils are not suitable for use as septic tank fields, though a few areas can be used. Some of the soils with severe limitations are better drained but are underlain by hard bedrock within 5 to 36 inches of the surface or have a thick, very slowly permeable hardpan that extends to a depth of more than 4 feet. Other soils have slopes exceeding 12 percent that severely limit the design and construction of sewage disposal systems.

These estimates do not eliminate the need for on-site investigation to determine the specific location and design of a system for disposing of sewage. The Nevada Department of Health should be contacted for information pertaining to the type and design of the method best suited to individual needs.

In the columns "Agricultural drainage" and "Irrigation," the words "Not applicable" indicate soils that probably will not be brought under irrigation, because they have one or more severe limitations that seriously restrict their use for intensive farming. Consequently, artificial drainage is not needed in these soils.

The soil features listed in the column "Irrigation" are those affecting the design of an efficient irrigation system. The average intake rate is expressed in relative terms, which are defined as follows: *Slow*—0.1 to 0.7 inch per hour; *moderate*—0.7 to 3.5 inches per hour and *rapid*—more than 3.5 inches per hour. Available water capacity

is given for a root zone 5 feet deep. Relief and slope, though not given, are inferred by suggested methods of irrigation. Border irrigation is suggested for smooth, nearly level soils; corrugation irrigation is suggested for smooth or slightly convex, gently sloping soils; and contour flooding or controlled flooding is suggested for undulating, nearly level soils.

In the column "Foundations," the ratings given for bearing capacity are estimated and should not be used to assign specific values of bearing capacity.

TABLE 7.—*Engineering test data for soil*

[Tests performed by the Nevada Department of Highways in accordance with standard

Soil name and location	Bureau of Public Roads report No.	Depth	Horizon	Percentage passing sieve [1]	
				3-in.	1½-in.
Adaven loam:		*Inches*			
Approximate center of sec. 27, T. 7 S., R. 61 E.	S–1883–61	2–11	C1		
	S–1885–61	50–60	C6		
0.3 mile S. and 420 feet W. of N. quarter corner of sec. 31, T. 8 S., R. 62 E.	S–1886–61	0–6	A1		
	S–1888–61	46–56	C6		
Alko loamy coarse sand, 0 to 8 percent slopes:					
1,550 feet N. of SW. corner of sec. 12, T. 7 S., R. 60 E.	S–1889–61	4–11	C2		
	S–1891–61	33–43	IIC5ca		
800 feet N. of SW. corner of sec. 7, T. 7 S., R. 61 E.	S–1892–61	4–16	C2		
	S–1894–61	55–68	IIC7		
Belted sandy loam:					
950 feet N. and 500 feet W. of S. quarter corner of sec. 17, T. 3 S., R. 55 E.	S–1862–61	0–3	A1		
	S–1863–61	11–24	C2		
	S–1864–61	40–60	IIC5		
Fang fine sandy loam, 0 to 2 percent slopes:					
0.6 mile E. and 0.22 mile N. of SW. quarter corner of sec. 31, T. 3 S., R. 55 E.	S–1865–61	0–3	A1		
	S–1866–61	3–13	C1		
	S–1867–61	20–39	C3		
0.25 mile E. of W. quarter corner of sec. 6, T. 4 S., R. 55 E.	S–1868–61	0–3	A1		
	S–1869–61	8–13	C2		
	S–1870–61	20–43	C4		
Tickapoo gravelly sandy loam, 2 to 4 percent slopes:					
0.2 mile E. of W. quarter corner of sec. 10, T. 4 S., R. 54 E.	S–1871–61	1–2	A1		100
	S–1872–61	5–10	B22t		
1,000 feet S. and 870 feet E. of NW. corner of sec. 9, T. 4 S., R. 54 E.	S–1874–61	0–3	A1		
	S–1875–61	5–11	B21t		
	S–1876–61	22–44	IIIC2si		
Tickapoo sandy loam, 2 to 4 percent slopes:					
0.25 mile E. and S. of NW. corner of sec. 3, T. 1 S., R. 55 W.	S–1877–61	0–3	A1		100
	S–1878–61	5–9	B2t		
	S–1879–61	17–25	B32ca		100
75 feet S. of N. quarter corner of sec. 2, T. 1 S., R. 55 E.	S–1880–61	0–3	A1	100	96
	S–1881–61	5–11	B2t		
	S–1882–61	26–34	C3sica		
Tippipah sandy loam:					
300 feet S. and 400 feet E. of NW. corner of sec. 31, T. 3 S., R. 55 E.	S–1859–61	0–4	A1	100	90
	S–1860–61	8–18	B21t		100
	S–1861–61	28–44	C1si		
520 feet N. of S. quarter corner of sec. 35, T. 3 S., R. 54 E.	S–1856–61	0–4	A1		
	S–1857–61	10–19	B21t		
	S–1858–61	35–46	IIC2si	100	95

[1] Mechanical analysis according to AASHO Designation: T 88–57 (*1*). Results by this procedure frequently may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for naming textural classes for soils.

Engineering test data

Soil samples from 13 profiles of six principal soil series in the Pahranagat-Penoyer Areas were tested by the Nevada Department of Highways, using standard AASHO procedures, to help evaluate the soils for engineering purposes. Only selected layers of each soil were sampled. The results of these tests are given in table 7.

samples taken from 13 soil profiles

procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Percentage passing sieve [1]—Continued					Liquid limit	Plasticity index	Classification	
¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)			AASHO	Unified [2]
----------	----------	100	97	77	43	12	A-7-5(9)	ML.
100	89	83	68	27	23	[3] NP	A-2-4(0)	SM.
----------	----------	100	99	58	26	NP	A-4(5)	ML.
----------	----------	100	99	92	41	10	A-5(8)	ML.
100	99	95	62	24	16	NP	A-2-4(0)	SM.
100	96	79	22	4	28	NP	A-1-b(0)	SP.
100	97	91	53	23	16	NP	A-2-4(0)	SM.
[4] 100	94	80	40	9	26	NP	A-1-b(0)	SP-SM.
----------	100	98	65	29	16	NP	A-2-4(0)	SM.
100	99	95	69	27	17	NP	A-2-4(0)	SM.
100	99	99	94	76	41	15	A-7-6(10)	ML-CL.
100	99	97	82	31	19	NP	A-2-4(0)	SM.
100	99	98	89	36	20	NP	A-4(0)	SM.
100	98	96	85	39	23	NP	A-4(1)	SM.
----------	100	97	78	32	19	NP	A-2-4(0)	SM.
100	99	98	84	31	18	NP	A-2-4(0)	SM.
100	98	97	82	18	20	NP	A-2-4(0)	SM.
99	92	88	50	46	25	NP	A-4(2)	SM.
100	99	96	84	58	52	32	A-7-6(14)	CH.
100	94	88	57	26	14	NP	A-2-4(0)	SM.
100	97	93	74	51	49	29	A-7-6(11)	CL.
100	87	69	29	5	24	NP	A-1-b(0)	SP-SM.
98	88	78	52	23	23	NP	A-2-4(0)	SM.
100	76	66	54	34	36	21	A-2-6(2)	SC.
99	70	52	30	13	24	11	A-2-6(0)	SC.
94	79	71	47	20	16	NP	A-1-b(0)	SM.
100	97	93	84	64	50	26	A-7-6(14)	CL.
100	87	77	56	19	36	NP	A-2-4(0)	SM.
88	83	79	59	17	17	NP	A-2-4(0)	SM.
98	88	83	67	28	35	11	A-2-6(0)	SM-SC.
100	91	81	55	12	22	NP	A-2-4(0)	SP-SM.
100	99	97	71	29	17	NP	A-2-4(0)	SM.
100	96	92	76	42	38	20	A-6(4)	SC.
93	73	54	21	3	22	NP	A-1-b(0)	SW.

[2] SCS and the Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SP-SM, ML-CL, and SM-SC.

[3] Nonplastic.

[4] Pebbles larger than one-half inch were discarded in field sampling.

Formation and Classification of Soils

In this section, the factors that influenced soil formation are discussed and the soils are classified in higher categories.

Soil Formation

Soil is a natural body on the surface of the earth in which plants grow. It is a mixture of rocks and minerals, organic matter, water, and air, all of which occur in varying proportions. The rocks and minerals are fragmented and partly or wholly weathered. Soils have more or less distinctive layers, or horizons, that are the product of environmental forces acting upon materials deposited or accumulated by geological agencies.

The characteristics of the soil at any given point are determined by the interaction of (1) the parent material; (2) the climate in which the soil material has accumulated and has existed since accumulation; (3) the relief, or topography, which influences the local, or internal, environment of the soil, its drainage, moisture content, aeration, susceptibility to erosion, and exposure to sun and wind; (4) the biological forces that act upon the soil material—the plants and animals living on and in it; and (5) the length of time the climatic and biological forces have acted on the soil material.

Parent material

Most of the soils in the Pahranagat-Penoyer Areas developed in sediments that were washed from the surrounding mountains and laid down by water. Locally, these sediments were reworked by wind. The remaining soils developed in residuum that weathered from rocks of the mountains.

In extensive areas the sediments were deposited as large, coalescing alluvial fans adjacent to the mountains. In many places the fans are dissected or truncated by channels of intermittent streams, as well as by the channel of the ancient White River. Lacustrine and eolian deposits occur in small areas on the floor of the Penoyer Valley.

The sediments in both valleys were derived mainly from ignimbrite and limestone. A smaller amount of material came from basalt, dolomite, shale, and quartzite. The dolomite, shale, and quartzite were interbedded with massive beds of limestone.

Ignimbrite is a stratified volcanic rock of Tertiary age that was produced from great fissures. It lies in nonsorted pyroclastic deposits consisting mainly of welded tuff having a rhyodacitic composition. In some places there is nonwelded tuff and tuff breccia.

Each flow of ignimbrite is several hundred feet thick and can be identified over a great distance. In addition, the ignimbrite in each flow has characteristic mineralogy, density, and susceptibility to weathering that make identification possible, much like those of a sedimentary rock. It is made up of glass shards, crystals, and lithic fragments, in that order of abundance. Minerals occurring as phenocrysts, in order of decreasing abundance, are quartz, sanidine, plagioclase feldspars, biotite, and hornblende. Not all of these minerals need be present in any one area of ignimbrite.

The effect of parent material on soil morphology is well illustrated by the soils of Penoyer Valley. In this enclosed basin, the temperature and precipitation are essentially the same for areas of equal elevation. The vegetation and relief also are similar. Hence, the morphological differences in soils of comparable age can be attributed solely to differences in parent material.

The mountains on the western side of Penoyer Valley consist almost entirely of ignimbrite. On the northeastern side, they are made up of sedimentary rocks, principally limestone, and on the southeastern side, they consist both of ignimbrite and of sedimentary rocks.

The Tickapoo soils developed in sediments derived chiefly from ignimbrite. They have a well-expressed B2t horizon that resulted from the weathering of clay-forming minerals, and they have a horizon strongly cemented with silica. The Crystal Springs soils, which are somewhat older than the Tickapoo soils, developed in sediments derived chiefly from sedimentary rocks. In these soils a B2t horizon is lacking, but there is a hardpan indurated with lime. The Silent soils, of about the same age as the Tickapoo soils, have a weakly expressed B2t horizon and a hardpan indurated with lime. These differences can be attributed to the weatherable nature of ignimbrite and to the influence of material rich in calcium that inhibits the formation and translocation of clays in an otherwise similar environment.

Recent sediments from ignimbrite not only are weathered readily, but they contribute additional characteristics to the soils. These soil materials have high cation-exchange capacity, and they contain clays of a 2-to-1 lattice type, presumably vermiculite and montmorillonite. Because the cation-exchange capacity is high, based on the content of clay and fine silt, it can be inferred that noncrystalline or amorphous silts also are present. The high values for exchangeable potassium indicate that sanidine is present.

The Pintwater and Nevoyer soils developed in residuum from ignimbrite; the Theriot soils, in residuum from dolomitic limestone; and the Tolicha soils, in residuum from basalt. The soils in each of these series are shallow or very shallow, are gravelly, stony, or very gravelly, and reflect the influence of the underlying parent rock.

Lacustrine sediments, lying on low terraces just above the floor in Penoyer Valley, show the effects of parent rock and of lake water rich in calcium carbonate. The Jarboe, McCutchen, and Puddle soils formed in these sediments. While they were forming, drainage was poorer than it is today because of an ancient lake nearby. The lake water contained calcium carbonate, and as it moved laterally and then evaporated, the soil material was highly impregnated with calcium carbonate.

In Pahranagat Valley the Adaven and Ash Springs soils have a somewhat similar genesis, but they are poorly drained or somewhat poorly drained and are influenced by warm water from adjacent springs. Because the Adaven soils are the nearer, they are the more strongly influenced. They are strongly cemented with lime, whereas the Ash Springs soils are only marly in the subsoil and are not cemented.

Climate

The Pahranagat Valley lies along the boundary of transition between the "hot desert" and the "cold desert" in Nevada. The climate is semiarid-continental and is representative of that in other valleys along this boundary in southern Nevada. Days are hot in summer but are cool in winter. Precipitation averages about 6.5 inches annually and comes mainly in winter and late in summer. The average temperature in January is 36° F., and in July it is 80°. The average annual temperature is about 58°. Daily ranges in temperature are wide; the average range is about 29° in winter and 42° in summer. The average frost-free season is about 165 days.

The Penoyer Valley, for which no data are available, is probably somewhat colder than Pahranagat Valley because it lies at a higher elevation. The estimated precipitation is 6.0 to 8.0 inches annually, depending on elevation, and most of it likely comes in winter and late in summer. The average frost-free season is thought to be about 150 days.

Climate generally determines the kind and density of plants that can grow in an area and hence the amount of organic matter that accumulates in the soils. Except for soils having a high water table, the soils in both valleys contain only a small amount of organic matter in the A horizon. The organic-matter content is low because rainfall is scanty, periods of sunshine are long, the temperature and rate of evaporation in summer are high, and consequently the stand of native plants is sparse. In contrast, such soils as the poorly drained Pahranagat soils were originally covered by a dense growth of plants that obtained most of their moisture from ground water rather than rainfall. These soils have a considerably higher content of organic matter.

A long time is required for sediments to weather in areas of low rainfall. In the Alko, Belted, Monte Cristo, Nyala, Pahroc, Sierocliff, Timpahute, and Tippipah soils, soil forming was accelerated by the high summer temperatures, but it was slowed by scanty rainfall. High temperatures encourage the rapid weathering of soil materials. In general, the speed of chemical reaction doubles for each rise of 10° C. in temperature. Where the climate is dry, however, the rate of weathering slows because scarcity of water limits the weathering that can take place. Water is a major source of hydrogen ions, a principal agent of weathering, and by carrying away the end products of chemical reactions, water allows the reactions to continue. If the depth of moisture penetration is limited, leaching also is limited, the end products accumulate, and weathering is slowed down or may be stopped.

It is likely that the soils listed in the foregoing paragraph formed in periods of the Pleistocene epoch when the climate was more favorable for soil formation than it is now. This can be inferred by comparing the soils on landforms of different ages. During various periods of the Pleistocene epoch, the White River established a well-defined channel along its entire length and emptied into the Colorado River. During such periods the river carried enough water to truncate the alluvial fans on both sides of the valley. Under the present climate, however, the White River is dry for many miles both above and below the Pahranagat Valley. Small alluvial fans are encroaching on the flood plain and, in many places, are impeding the normal flow of water. This flow is entirely from hot springs along the margins of the valley.

In the Penoyer Valley, evidence of formerly higher rainfall is suggested by relics of lake-deposited and truncated terraces. These relics now surround the dry lakebed, or playa, on the valley floor.

Biological activity

On the alluvial fans and terraces, and in the surrounding hills and mountains, the plants are desert shrubs and grasses. Because the soils are well drained to excessively drained and are dry for long periods, these plants cover only a small part of the surface. They add little organic matter to the soil, give scant protection from water and wind, and provide meager shade. For this reason, the soils have a low organic-matter content and are poor habitats for micro-organisms.

Typical of these well-drained to excessively drained soils are the Alko, Belted, Tickapoo, and Tippipah soils. In all of these, the A horizon has only half the percentage of organic carbon that is in the next horizon below it. Organic matter in the A horizon is rapidly oxidized during long periods of heat and sunshine, but it is accumulated in the underlying horizon because the A horizon tends to insulate it.

On parts of the flood plain where the water table is low but moisture is received as runoff from higher areas, the soils support a relatively dense growth of native shrubs and grasses. In these soils, such as the Fang soils, the organic-matter content is low but appreciably higher than that in soils on the uplands.

In low areas on the flood plain, where the water table is generally high, the vegetation is a lush growth of phreatophytes, or deep-rooted plants that obtain their moisture from ground water or the layer of soil just above it. These plants cover 5 to 20 percent of the surface, depending on the content of salts and alkali in the soil. In most places they furnish a moderate to large amount of organic matter, protect the soil from erosion, provide adequate shade, and are a good habitat for micro-organisms. In the soils more strongly affected by salts and alkali, however, the habitat for micro-organisms is poor.

On the more poorly drained soils of the flood plain, the vegetation consists of water-loving grasses and other aquatic plants. While the soils were forming, drainage was poor, water was readily available, and the native plants grew abundantly. Consequently, these soils are the darkest in either valley, except where they are influenced by lime-rich spring water. Most of them have an organic-matter content above 3 percent and provide a good habitat for micro-organisms. The Pahranagat soils are an example of these poorly drained soils on the flood plain.

Relief and drainage

The Pahranagat and Penoyer Valleys are in the Great Basin section of the Basin and Range province (*3*). They resemble other valleys of the province in most respects. The Pahranagat Valley is drained by the channel of the ancient White River, whereas the Penoyer Valley consists of a basin filled with alluvium. Both valleys are surrounded by sharp, rugged, essentially parallel mountain ranges of complex structure.

The Pahranagat Valley is bounded on the west by the Pahranagat Range, which rises to an elevation of about 8,700 feet above sea level. In the mountains that bound the valley on the east, the highest points are 6,220 feet in the Hiko Range and 7,950 feet in the Pahroc Range. Only peripheral parts of these mountains are in the Pahranagat survey area. Elevations in the valley range from about 3,600 feet at Maynard Lake in the southern end to about 4,200 feet near Seaman Wash in the northern end.

Pahranagat Valley consists of three distinct topographic features: steep mountain slopes, alluvial fans and terraces, and the flood plain. Minor topographic features include small drainage channels that dissect the major alluvial fans and terraces.

The White River, an ancient perennial stream that was a tributary of the Colorado River, flowed through Pahranagat Valley from the north. It established a well-defined but relatively narrow flood plain, and through normal cutting it truncated the alluvial fans and terraces on both sides of the valley. Today, the riverbed is dry for many miles upstream and downstream from Pahranagat Valley, but there is water in the valley that comes from large thermal springs along the flood plain. The spring water rarely flows past Maynard Lake at the southern end of the survey area.

The mountain ranges to the east and west of the valley rise abruptly as a result of faulting. Large, almost vertical outcrops of rock are common. The well-drained or somewhat excessively drained Pintwater and Theriot soils developed in material weathered from rock in the less sloping parts of these mountains.

Below the mountain ranges there are long alluvial fans that are relatively smooth or gently convex and are nearly level to moderately sloping. They are dissected by many deep drainage channels, a few of which are several hundred feet wide. On these alluvial fans the well-drained Alko and Pahroc soils developed. Along the drainage channels and on small alluvial fans, in sediments more recently deposited, the well-drained to excessively drained Carrizo, Stumble, Sundown, Maynard Lake, Penoyer, and Seaman soils developed.

Dissection of the alluvial fans doubtless occurred while the White River was a perennial stream, which removed a considerable amount of eroded material from the valley. Since that time the fans have been subjected to further dissection and to deepening of the older channels. A result has been the formation of small, convex alluvial fans on the White River flood plain. In many areas the small fans have impeded the normal flow of drainage water downstream and have raised the water table in adjacent soils. The moderately well drained and somewhat poorly drained Geer and Bastian soils, as well as the water table phases of the Seaman soils, have developed on these alluvial fans. Because of impeded drainage, these soils are affected by salts and alkali in some places.

In the Bastian soils there are nodules that are weakly cemented with silica and that formed as a result of strong alkalinity caused by a soil solution high in content of sodium. The silica in these soils came from ignimbrite. It is soluble at a high pH. Because the pH in the surface layer was high (above 9.0), the silica went into solution and moved downward to the water table, where soluble salts were dominant and the pH was lower than in the surface layer. Because of the lower pH, the silica precipitated out of solution and gradually a Csi horizon, or horizon of weakly cemented silica nodules, was formed.

In Pahranagat Valley the flood plain of the White River is relatively narrow and is nearly level. It consists mainly of material laid down by the river, but some material came from the side washes. The material was deposited during floods, or it settled in shallow lakes or oxbows.

Soils on the flood plains are mostly poorly drained. They are mainly the light-colored, medium-textured Ash Springs soils and the dark-colored, stratified, medium-textured to fine-textured Pahranagat soils. The difference in the color of these soils does not indicate a difference in the organic-matter content, but it is related to the content of calcium carbonate that effectively masks the soil color.

The colors of soils are strongly influenced by iron—a constituent of many minerals that is largely responsible for the bright colors in soils. Iron generally occurs in the ferric form and in this form is insoluble if air is present. But in soils containing large amounts of organic matter and water, iron is reduced to ferrous forms that are soluble and move readily in water. This change, called reduction, takes place in soils on the flood plain. Ferrous iron goes into solution and is removed from the soil in drainage water. As a result, the colors of these soils are materially affected. They have (1) chromas of less than 2; (2) hues of neutral or yellow (2.5Y or 5Y); or both such chromas and hues. Soils that have yellowish hues are sometimes referred to as gleyed. The Pahranagat soils are examples of poorly drained soils in which the colors have been influenced by iron.

The Penoyer Valley is an undrained basin that is bounded on the west by the Quinn Canyon Range, which rises to an elevation of more than 7,000 feet. On the northeast the valley is bounded by the Worthington Mountains, where the highest elevation is about 6,800 feet; and on the southeast, by the Timpahute Range, where the highest point is more than 9,000 feet above sea level. Only peripheral parts of these mountains are in the Penoyer survey area. The valley is without external drainage, but on the valley floor is a playa that lies at an elevation of nearly 4,700 feet. There are no live streams in the valley.

Penoyer Valley consists of three distinct topographic features: steep mountain slopes, alluvial fans, and the central lowlands. Among the minor features are intermittent drainage channels that dissect parts of the alluvial fans. Other features are low-lying lacustrine terraces, the central playa, and dunes scattered on the playa surface and around the margin.

To the east and west of the valley, the mountain ranges commonly rise abruptly above the flanking alluvial apron as a result of faulting. In some areas, however, the rise is only gradual. Generally, these mountains are much less striking in appearance than those bounding the Pahranagat Valley, for they lack the large vertical outcrops of rock and, in most places, the very steep side slopes. The Pintwater and Theriot soils developed in material that weathered from rocks in the steeper

mountains above the Penoyer Valley. The Nevoyer and Tolicha soils developed in material that weathered in the moderately sloping to strongly sloping mountains and foothills. All of these soils are well drained or somewhat excessively drained.

Below the mountain ranges are nearly level to strongly sloping alluvial aprons. The upper part of the aprons consists of many, gently sloping to strongly sloping, deeply dissected and truncated older alluvial fans adjacent to the mountain slopes. The well-drained and somewhat excessively drained Crystal Springs, Sierocliff, Specter, and Timpahute soils occupy these fans. In intermediate areas below them, there are many coalescing alluvial fans that are mostly smooth, gently convex, and nearly level to moderately sloping. Locally, these fans are deeply dissected, but in most places they are cut only by shallow drainage channels. The well-drained Monte Cristo, Nyala, Silent, Tickapoo, and Timper soils are dominant in these areas.

The low areas on alluvial fans are broad, smooth, and nearly level to gently sloping. They are dissected only by relatively shallow drainage channels. The well-drained and somewhat excessively drained Aysees, Koyen, and Papoose soils occur in these low areas.

Intermittent streams that originate in the surrounding mountains have cut channels in the alluvial apron. The major channels are narrow near their source, but they are several hundred feet wide near the valley floor. These channels are dry most of the time; they carry water only during high-intensity storms. The excessively drained and somewhat excessively drained, very gravelly, coarse-textured Bluewing and Leo soils are the major soils in channels at the higher elevations. Progressively downslope, the soils in channels are the well-drained, moderately coarse textured Cliffdown soils; the well-drained, moderately coarse textured Fang soils; and the well-drained, silty Woodrow soils.

The Jarboe and Puddle soils, which occupy low-lying lacustrine terraces, are well drained or moderately well drained today, but there is evidence that these soils were more poorly drained while they were developing. They are impregnated by lime that was precipitated through the evaporation of lime-rich ground water, and they are mottled or spotted with oxidized iron. The McCutchen soils lack the mottles caused by the oxidation of iron, but in other respects they are similar to the Jarboe and Puddle soils.

The water table in these soils fluctuated as the lake level was lowered by surface evaporation. In soils that have a fluctuating water table, iron is reduced but is not removed in drainage water. As the water table falls, soil aeration improves, the content of oxygen increases, and the ferrous iron in solution is oxidized and precipitated as ferric oxide. Ferric oxide is reddish in color, and it mottles the soil in places where it is precipitated.

In both the Pahranagat and the Penoyer Valleys, many of the soils are affected by salts and alkali. The water table is near the surface in these soils, and the ground water has a high content of dissolved salts. Excess salts and alkali accumulate, generally on or near the surface, when saline ground water rises through capillary action and is evaporated. In addition, such plants as greasewood and shadscale, through their normal growth cycle, tend to accumulate salts in the soil.

Below the lacustrine terraces in Penoyer Valley is the dry lakebed, or playa. This is periodically flooded when high-intensity rainstorms cause runoff on high-lying soils. On the surface of the playa there are semi-stabilized dunes, laid down and reworked by wind, in which the sandy, excessively drained Kawich soils developed.

Time

The soils in the Pahranagat-Penoyer Areas vary in age. The time available for a soil to develop in unconsolidated sediments is the time that has elapsed since the last sediments were laid down. Soils on sedimentary or igneous rocks began to develop after the parent rocks weathered into permeable material.

In general, the flood plain consists of the most recent alluvium, and the high alluvial fans are composed of the oldest. Soil material in the lower alluvial fans, the lacustrine terraces, and the mountains ranges from young to intermediate in age.

Soils on the flood plain have little or no profile development other than the formation of an A1 horizon. In many areas this horizon is obscured by recent deposition of material or by erosion. Soils in the mountains and foothills vary somewhat in degree of development. All have a thin A1 horizon, and in the Nevoyer soils, the oldest, a weak structural B2 horizon and a weak Cca horizon, containing accumulated calcium carbonate, have formed.

Soils on the alluvial fans vary widely in degree of development and in the type of horizons formed. All have a thin A horizon, a base saturation percentage of 100, concentrations of salts and sodium that increase with increasing depth, and pH values of more than 8.0 in a 1:5 dilution.

The youngest soils on alluvial fans have weakly expressed horizons. The Papoose soils have a thin, moderately fine textured B2t horizon and contain an accumulation of calcium carbonate. On the other hand, the Aysees soils lack a textural B2t horizon but have a sufficient accumulation of calcium carbonate to develop a calcic horizon.

Soils of intermediate age on alluvial fans are more strongly developed and have readily discernible horizons. The Tickapoo soils have a thin, fine-textured B2t horizon and a Csicam horizon that are strongly cemented with silica and calcium carbonate. The Timper soils lack a B2t horizon, but they have a Csicam horizon that is strongly cemented with silica and calcium carbonate.

Soils on the oldest fans are the most strongly developed. The Timpahute soils have a thin, fine-textured B2t horizon and a hardpan that is indurated with silica and lime. The Alko and Crystal Springs soils lack a B2t horizon, but they have a thick, massive, indurated hardpan. In the Alko soils the hardpan is cemented primarily by silica, but calcium carbonate also is present. The primary cementing agent in the hardpan of the Crystal Springs soils is calcium carbonate. Both hardpans are the result of accumulations over an extremely long period of time.

265-477—68——9

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First, through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and applied in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. They are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of classifying soils currently used in the United States is discussed in Soil Classification, a Comprehensive System, published in 1960 (*9*). An amendment to this publication was issued in 1964. The current system was adopted for general use by the National Cooperative Soil Survey in 1965. The system is under continual study (*7*), and readers interested in developments of this system should search for the latest literature available.

In table 8 the soils of the Pahranagat-Penoyer Areas are classified according to the current system and its 1964 amendment. The classes in this system are briefly defined in the following paragraphs.

TABLE 8.—*Soil series classified according to the present system of classification* [1]

Series	Family	Subgroup	Order
Adaven	Coarse-loamy, mixed, mesic	Andic Aquic Calciorthids	Aridisols.
Alko	Coarse-loamy, mixed, thermic	Typic Durorthids	Aridisols.
Ash Springs	Coarse-loamy, mixed, mesic	Aquic Calciorthids	Aridisols.
Ash Springs, heavy subsoil variant.	Fine, montmorillonitic, calcareous, mesic	Typic Haplaquolls	Mollisols.
Aysees	Sandy skeletal, mixed, mesic	Typic Calciorthids	Aridisols.
Bastian	Fine-loamy, mixed, calcareous, mesic	Durorthidic Udorthents	Entisols.
Belted	Fine-loamy, mixed, mesic	Haplic Durargids	Aridisols.
Bluewing	Sandy skeletal, mixed, nonacid, mesic	Typic Torripsamments	Entisols.
Carrizo	Sandy skeletal, mixed, nonacid, thermic	Typic Torripsamments	Entisols.
Cliffdown	Coarse-loamy, mixed, calcareous, mesic	Typic Torriorthents	Entisols.
Crystal Springs	Coarse-loamy, carbonatic, mesic	Petrocalcic Calciorthids	Aridisols.
Fang	Coarse-loamy, mixed, calcareous, mesic	Andic Torriorthents	Entisols.
Geer	Coarse-loamy, mixed, calcareous, mesic	Typic Torrifluvents	Entisols.
Jarboe	Fine-silty, carbonatic, mesic	Aquic Calciorthids	Aridisols.
Kawich	Sandy, mixed, nonacid, mesic	Andic Torripsamments	Entisols.
Koyen	Coarse-loamy, mixed, mesic	Andic Camborthids	Aridisols.
Lahontan, water table variant	Fine-silty, mixed, calcareous, mesic	Typic Halaquepts	Inceptisols.
Lahontan, poorly drained variant.	Fine, montmorillonitic, calcareous, mesic	Typic Halaquepts	Inceptisols.
Leo	Sandy skeletal, mixed, calcareous, mesic	Andic Torriorthents	Entisols.
Maynard Lake	Sandy, mixed, nonacid, thermic	Andic Torripsamments	Entisols.
McCutchen	Coarse-loamy, mixed, mesic	Andic Calciorthids	Aridisols.
Monte Cristo	Fine-loamy, mixed, mesic	Haplic Nadurargids	Aridisols.
Nevoyer	Loamy, mixed, mesic	Andic Lithic Camborthids	Aridisols.
Nyala	Fine-loamy, mixed, mesic	Duric Natrargids	Aridisols.
Pahranagat	Fine-silty, mixed, calcareous, mesic	Typic Haplaquolls	Mollisols.
Pahroc	Coarse-loamy, mixed, mesic	Typic Durorthids	Aridisols.
Papoose	Fine-loamy, mixed, mesic	Andic Haplargids	Aridisols.
Penoyer	Coarse-silty, mixed, calcareous, mesic	Typic Torriorthents	Entisols.
Pintwater	Loamy skeletal, mixed, calcareous, mesic	Andic Lithic Torriorthents	Entisols.
Puddle	Coarse-loamy, carbonatic, mesic	Aquic Calciorthids	Aridisols.
Seaman	Coarse-loamy, mixed, calcareous, thermic	Andic Torriorthents	Entisols.
Sierocliff	Loamy skeletal, mixed, mesic	Petrocalcic Calciorthids	Aridisols.
Silent	Fine-loamy, mixed, mesic	Natric Petrocalcic Haplargids	Aridisols.
Silverbow	Loamy skeletal, mixed, mesic	Haplic Durargids	Aridisols.
Specter	Loamy skeletal, mixed, mesic	Typic Durorthids	Aridisols.
Stumble	Sandy, mixed, nonacid, mesic	Andic Torripsamments	Entisols.
Sundown	Sandy, mixed, nonacid, mesic	Andic Torripsamments	Entisols.
Theriot	Loamy skeletal, carbonatic, mesic	Lithic Torriorthents	Entisols.
Tickapoo	Fine, mixed, mesic	Haplic Nadurargids	Aridisols.
Timpahute	Fine, montmorillonitic, mesic	Typic Nadurargids	Aridisols.
Timper	Coarse-loamy, mixed, mesic	Entic Durorthids	Aridisols.
Tippipah	Fine-loamy, mixed, mesic	Haplic Nadurargids	Aridisols.
Tolicha	Loamy, mixed, calcareous, mesic	Lithic Torriorthents	Entisols.
Woodrow	Fine-silty, mixed, calcareous, mesic	Typic Torrifluvents	Entisols.

[1] Placement of some soil series in the present system of classification may change as more precise information becomes available.

ORDER: Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Table 8 shows the four soil orders in the Pahranagat-Penoyer Areas—Entisols, Inceptisols, Aridisols, and Mollisols.

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The suborder is not shown in table 8.

GREAT GROUP: Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that have pans interferring with growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 8, because the name of the great group is the last word in the name of the subgroup.

SUBGROUP: Great groups are subdivided into subgroups, one representing the central (typic) segment of the group and others, called intergrades, that have properties of one great group and also one or more properties of another great group, subgroup, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, subgroup, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquolls.

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils where used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. An example is the fine silty, mixed, calcareous, mesic family of Typic Haplaquolls.

SERIES: The series consists of a group of soils that formed from a particular kind of parent material and having genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, structure, reaction, consistence, and mineralogical and chemical composition.

New soil series must be established and concepts of some established series, especially older ones that have been used little in recent years, must be revised in the course of the soil survey program across the country. A proposed new series has tentative status until review of the series concept at state, regional, and national levels of responsibility for soil classification result in a judgment that the new series should be established. Thirty of the soil series described in this publication had tentative status when the survey was sent to the printer. They are the Adaven, Alko, Aysees, Bastian, Belted, Cliffdown, Crystal Springs, Fang, Jarboe, Kawich, Koyen, Leo, McCutchen, Monte Cristo, Nevoyer, Nyala, Papoose, Pintwater, Puddle, Seaman, Sierocliff, Silent, Silverbow, Specter, Stumble, Sundown, Tickapoo, Timper, Tippipah, and Tolicha series. The other series used in this survey were established earlier.

Descriptions of soil series by subgroups

A discussion of the soil series in the Pahranagat-Penoyer Areas by subgroups is given in this subsection.

Typic Torripsamments: The Bluewing and Carrizo soils are in this subgroup. These soils occur along flood plains and on short alluvial fans. They are very gravelly, coarse textured, and excessively drained. In some of the soils a small accumulation of lime has formed in a weak Cca horizon.

The Bluewing soils are representative of this subgroup. Typically, they have an AC profile; a very thin, light brownish-gray A1 horizon; a weak Cca horizon in which secondary accumulations of lime coat the lower side of coarse fragments; and an average annual soil temperature of about 53° F.

The Carrizo soils are similar to the Bluewing soils, but they lack a weak Cca horizon, and they developed in a climate in which the average annual temperature of the soil is more than 59° F.

Andic Torripsamments: The Kawich, Maynard Lake, Stumble, and Sundown soils are in this subgroup. These soils occur on alluvial fans, terraces, and flood plains and on partially stabilized dunes built up by wind. They are coarse textured and somewhat excessively drained or excessively drained. Some of the soils are gravelly. In the Stumble soils there is accumulated lime that forms a weak Cca horizon. For all the soils in this subgroup, the calculated cation-exchange capacity, expressed as milliequivalents per 100 grams of clay, is about twice as high as that expected for soils having a sandy texture.

Soils of the Sundown series are representative of this subgroup. Typically, they have a very thin, light-gray A1 horizon underlain by a light-gray or very pale brown C horizon that is slightly stratified but is dominantly loamy fine sand. The soils are calcareous throughout the profile. They have an average annual temperature of about 52° F.

The Kawich soils are similar to the Sundown soils, but their control section consists of fine sand that is structureless (single grain) and is loose when dry or moist. Maynard Lake soils are at least one-half unit of value darker than Sundown soils throughout the profile, and they formed in a climate in which the average annual temperature of the soil is more than 59° F. The Stumble soils, unlike the Sundown soils, are noneffervescent to a depth of 10 to 15 inches, and they have a weak Cca horizon containing an accumulation of lime.

Typic Torrifluvents: In this subgroup are the Geer and Woodrow soils. These somewhat poorly drained, moderately well drained, and well drained soils lie on smooth, nearly level flood plains and on the toe slopes of alluvial fans. They formed in stratified, medium-textured and moderately fine textured sediments. Organic matter is distributed unevenly through the profile because, during the period when the sediments were de-

posited and the soils were forming, the conditions favorable for organic matter to accumulate varied from time to time.

The Geer soils are representative of this subgroup. Typically, these soils have an AC profile, are pale brown or very pale brown throughout, are stratified but dominantly medium textured, have a clay content of less than 18 percent in the control section, are calcareous, and are somewhat poorly drained and moderately well drained.

The well-drained Woodrow soils are similar to the Geer soils, but their weighted average texture, between the depths of 10 and 40 inches, is more than 18 percent clay and less than 15 percent material that is coarser textured than very fine sand.

Typic Torriorthents: The Cliffdown and Penoyer soils are in this subgroup. These well-drained soils generally occupy smooth, nearly level and gently sloping alluvial fans and flood plains. They formed in gravelly, moderately coarse textured alluvium or in silty alluvium.

The Cliffdown soils are representative of the subgroup. Characteristically, these soils are well drained, gravelly, and moderately coarse textured. They have a very thin, light brownish-gray A1 horizon underlain by a light brownish-gray and light-gray C horizon. These soils are calcareous throughout.

The Penoyer soils are similar to the Cliffdown soils, but they are not gravelly. Moreover, between the depths of 10 and 40 inches, less than 15 percent of their weighted average texture is coarser than very fine sand.

Andic Torriorthents: The Fang, Leo, and Seaman soils are in this subgroup. These soils developed in alluvium that was either moderately coarse textured or very gravelly and coarse textured. They generally occupy smooth, nearly level to gently sloping alluvial fans, but in places their slopes are stronger. The soils are well drained or somewhat excessively drained.

Soils of the Fang series are representative of this subgroup. Characteristically, these soils have a very thin, light brownish-gray A1 horizon underlain by a moderately coarse textured C horizon. They are weakly calcareous throughout and are well drained. Their average annual temperature is about 50° F. (Laboratory data for a typical Fang soil are given in tables 9 and 10.)

The Leo soils are similar to the Fang soils but are somewhat excessively drained. Also, between the depths of 10 and 40 inches, their weighted average texture is sandy, and more than 50 percent consists of particles larger than 2 millimeters in size. The Seaman soils have formed in areas where the average annual soil temperature is higher than 59° F., but otherwise, they are similar to Fang soils.

Andic Lithic Torriorthents: Only the Pintwater soils are in this subgroup. They are well-drained or somewhat excessively drained, very stony, moderately coarse textured soils that developed in residuum from ignimbrite. They are on sloping to very steep hills and mountain ridges. The soils contain secondary accumulations of lime that forms a weak Cca horizon and coats the underlying bedrock.

Lithic Torriorthents: In this subgroup are the Theriot and Tolicha soils. These soils developed in residuum from basalt or limestone. Some of them are gravelly, stony, and moderately coarse textured, and others are very stony and medium textured. They occupy moderately sloping or strongly sloping foothills and steep or very steep, broken ridges and side slopes in the mountains. In some places the soils contain secondary accumulations of lime, which forms crusts on the lower sides of stones. In addition, the Tolicha soils are covered by a well-developed gravel pavement consisting of pebbles that are coated on exposed surfaces with a burnished, dark-brown desert varnish consisting of iron and manganese oxides.

Typical of this subgroup are the Theriot soils. They are well-drained, very stony, medium-textured soils that developed in residuum from dolomitic limestone. They have a thin, light brownish-gray A1 horizon that contains more than 40 percent calcium carbonate or its equivalent. Below a depth of 10 inches, more than 50 percent of the soil mass is coarse fragments.

The Tolicha soils are similar to the Theriot soils, but they contain less than 40 percent calcium carbonate or its equivalent, and, below a depth of 10 inches, their content of coarse fragments is less than 50 percent.

Durorthidic Udorthents: Only the Bastian soils are in this subgroup. These soils are medium textured and somewhat poorly drained. They lie along the outer edges of flood plains and on toe slopes of adjacent alluvial fans.

Typic Halaquepts: The Lahontan soils, poorly drained variant, and the Lahontan soils, water table variant, are in this subgroup.

Representative of the subgroup are the Lahontan soils, poorly drained variant. These soils typically are fine textured and strongly affected by salts and alkali. They developed in flat areas or in slight depressions at the lower end of Pahranagat Valley.

The Lahontan soils, water table variant, are stratified, are moderately fine textured, and contain less than 35 percent clay and less than 15 percent material that is fine sand or coarser textured than fine sand. In other respects, they are similar to the Lahontan soils, poorly drained variant.

Typic Calciorthids: The Aysees soils are in this subgroup. These well-drained or somewhat excessively drained, moderately coarse textured soils occupy nearly level or gently sloping alluvial fans. Between the depths of 10 and 40 inches, they have a weighted average texture of loamy fine sand or coarser and contain more than 50 percent coarse fragments.

Andic Calciorthids: Only the McCutchen soils are in this subgroup. These well-drained, medium-textured soils developed on the lower part of alluvial fans near a playa or just above it. While the soils were developing, drainage was somewhat poor. The playa contained water that moved laterally into the soils and brought calcium carbonate, which accumulated as the water evaporated. Consequently, a thick Cca horizon formed in these soils.

Andic Aquic Calciorthids: Only the Adaven soils are in this subgroup. These soils are stratified, medium textured and moderately coarse textured, and somewhat poorly drained. They lie on nearly level toe slopes of

alluvial fans, in areas where the fans merge with the wet flood plain, and they are adjacent to thermal springs. Because the spring water is rich in lime, these soils contain a considerable amount of lime and have a strongly cemented Cca horizon. In addition, because of a fluctuating water table, the soils contain mottles having high chroma in places where ferric oxide was precipitated.

Aquic Calciorthids: The Ash Springs, Jarboe, and Puddle soils are in this subgroup. These moderately coarse textured to moderately fine textured soils developed in areas where drainage was somewhat poor or poor. They are on nearly level flood plains and on lake-formed terraces or shorelines. They have a Cca or a Ccam horizon (calcic horizon) caused by the evaporation of lime-rich ground water, which moved into the soils from an adjacent lake or adjacent thermal springs. In some of the soils there was a fluctuating water table that resulted in high-chroma mottling from the precipitation of ferric oxide. All of the soils are affected by salts and alkali.

The Puddle soils are typical of this subgroup. These soils are uniformly light gray; have a control section in which the clay content is less than 18 percent after mixing; are mottled, between the depths of 20 and 40 inches, with oxidized iron having high chroma; contain more than 40 percent calcium carbonate or its equivalent; and have a thick, prominent Cca (calcic) horizon. The Puddle soils developed along the shoreline of a prehistoric lake, where drainage was somewhat poor or poor. Later, the lake water was evaporated and the water table was lowered. The soils now are well drained.

The Ash Springs soils, unlike the Puddle soils, contain less than 40 percent calcium carbonate or its equivalent, and their drainage now is somewhat poor or poor. The Jarboe soils have a weighted soil texture, between the depths of 10 and 40 inches, that is more than 18 percent clay and is less than 15 percent fine sand or coarser than fine sand.

Petrocalcic Calciorthids: In this subgroup are the Crystal Springs and Sierocliff soils. These soils are well drained, medium textured or moderately coarse textured, and gravelly, very gravelly, or cobbly. The soils are on old dissected alluvial fans that are gently sloping to strongly sloping. The lime in the C horizon accumulated through repeated wetting over a long period of time.

The Crystal Springs soils are typical of this subgroup. Characteristically, they have a very thin, very pale brown A1 horizon; a gravelly and cobbly, medium-textured control section that is less than 50 percent coarse fragments; and an indurated Cca horizon at a depth of 11 to 24 inches. Crystal Springs soils contain more than 40 percent calcium carbonate or its equivalent.

In contrast, the Sierocliff soils are more than 50 percent coarse fragments above the hardpan, and they contain less than 40 percent calcium carbonate or its equivalent above the hardpan. Their root zone is 20 to 30 inches deep and is slightly deeper than that of the Crystal Springs soils.

Andic Camborthids: Only the Koyen soils are in this subgroup. These well-drained, moderately coarse textured soils occupy gently sloping alluvial fans. They are free of lime in their A1 and B2 horizons, but they have a Cca horizon. Their B and C horizons contain so little clay that the soil particles in these horizons apparently have not formed peds, or natural aggregates.

Andic Lithic Camborthids: The Nevoyer soils are in this subgroup. These soils are shallow or very shallow, somewhat excessively drained, gravelly, and medium textured. They formed in residuum from ignimbrite on steep to very steep mountain slopes. Nevoyer soils are free of lime in their A and B horizons, but they have a Cca horizon above bedrock.

Typic Durorthids: The Alko, Pahroc, and Specter soils are in this subgroup. These soils are very shallow to moderately deep, somewhat excessively drained or well drained, and moderately coarse textured or medium textured. Some are very gravelly. The soils in this subgroup lie on nearly level to strongly sloping old alluvial fans, some of which are deeply dissected. Over a long period of time, accumulations of secondary silica have formed an indurated Csi horizon in these soils.

The Alko soils are typical of this subgroup. Characteristically, they are well drained; have a very thin, light brownish-gray A1 horizon and moderately coarse textured C horizon; and contain a silica- and lime-indurated hardpan having a laminar surface. The Alko soils developed in a warm climate in which the average annual temperature of the soil is about 60° F. (Laboratory data for a typical Alko soil are given in tables 9 and 10.)

The Pahroc soils are medium textured and gravelly above the hardpan, and they developed in a climate in which the average annual temperature of the soil is less than 59° F., but they are similar to the Alko soils in other respects. The Specter soils, unlike the Alko soils, are more than 50 percent coarse fragments above the hardpan, are 24 to 36 inches deep over the hardpan, and developed in a climate in which the average annual soil temperature is less than 59° F.

Entic Durorthids: Only the Timper soils are in this subgroup. These shallow, well-drained, moderately coarse textured soils developed on old flood plains or nearly level, low-lying terraces. They have a strongly cemented hardpan that lacks a continuous, indurated, laminar surface. Their morphology also suggests that drainage was poorer while the soils were developing than it is today.

Andic Haplargids: The well-drained, medium-textured Papoose soils are in this subgroup. These soils have been in place long enough to have weathered some minerals from the parent rock into clay and to have formed a B2t horizon through illuviation. They developed on nearly level or gently sloping alluvial fans.

Duric Haplargids: In this subgroup are the Nyala soils. These are well-drained, moderately fine textured soils that developed on gently sloping alluvial fans. They have a B2t horizon formed through illuviation, and there are secondary accumulations sufficient for weakly cementing the Csi horizon.

Natric Petrocalcic Haplargids: Only the Silent soils are in this subgroup. They are shallow or moderately deep, well drained, and moderately fine textured. Their B2t horizon contains more than 15 percent exchangeable

sodium and is underlain by a hardpan indurated with lime. The Silent soils occur on smooth to somewhat convex, gently sloping to strongly sloping alluvial fans.

Haplic Durargids: The Belted and Silverbow soils are in this subgroup. These soils are very shallow or shallow, well drained, and moderately fine textured. They contain a strongly cemented duripan. The Belted soils are on nearly level alluvial terraces that lie on older deposits in lakebeds and basins. The Silverbow soils, which are very stony, occur on strong colluvial slopes of low-lying andesitic hills.

The Belted soils are typical of this subgroup. These soils characteristically have a thin, light-gray A1 horizon; a very thin, weakly expressed, light-gray, moderately fine textured B2t horizon; a duripan strongly cemented with silica and lime; and a IIC horizon consisting of silty lake-laid material that contains relic mottles of oxidized iron having high chroma. (Laboratory data for a typical Belted soil are given in tables 9 and 10.)

The Silverbow soils, in contrast to the Belted soils, contain more than 50 percent coarse fragments (stones) in the illuvial horizon, and they lack a IIC horizon made up of unconformable silty material that is mottled with oxidized iron.

Typic Nadurargids: Only the Timpahute soils are in this subgroup. These moderately deep, well-drained, fine-textured soils have a prismatic B2t horizon that contains more than 15 percent exchangeable sodium, and they have an indurated silica hardpan. They developed on gently sloping to strongly sloping, old, dissected alluvial fans.

Haplic Nadurargids: The Monte Cristo, Tickapoo, and Tippipah soils are in this subgroup. These are well-drained, moderately fine textured and fine textured soils that contain a duripan. They occupy nearly level to strongly sloping alluvial fans or terracelike remnants.

The Tickapoo soils are typical of this subgroup. Characteristically, these soils have a thin, light-gray A1 horizon; a moderately expressed, brown, prismatic, fine-textured B2t horizon of mixed mineralogy that contains more than 15 percent exchangeable sodium; and a duripan consisting of thin lenses of material strongly cemented with silica and lime. They are calcareous in the lower B and the C horizons. (Laboratory data for a typical Tickapoo soil are given in tables 9 and 10.)

TABLE 9.—*Physical data*

[Analyses made at Soil Survey Laboratory, Soil Conservation

Soil	Horizon	Depth	Textural Class	Particle-size distribution		
				Very coarse sand (2.0 to 1.0 mm.)	Coarse sand (1.0 to 0.5 mm.)	Medium sand (0.5 to 0.25 mm.)
		Inches		*Percent*	*Percent*	*Percent*
Adaven loam: *Location:* Pahranagat Valley. (*Survey No.* 59-Nev-9-30-1 to 9-30-7; *Laboratory No.* 59773-59779.)	A1	0-2	Silty clay loam	0.4	0.5	0.6
	C1	2-11	Silt loam	.2	.7	1.8
	C2ca	11-16	Fine sandy loam	1.4	4.6	7.8
	C3ca	16-24	Fine sandy loam	1.4	4.6	5.2
	C4cam	[1] 24-39				
	C5	39-50	Sandy loam	8.6	15.5	8.9
	C6	50-60	Fine sandy loam	6.1	13.8	8.9
Alko loamy coarse sand: *Location:* Pahranagat Valley. (*Survey No.* 59-Nev-9-32-1 to 9-32-7; *Laboratory No.* 59787-59793.)	A1	0-1	Coarse sand	22.3	35.4	15.2
	C1	1-4	Coarse sand to coarse sandy loam.	10.4	26.9	17.4
	C2	4-11	Coarse sandy loam	17.2	25.7	15.0
	C3sicam	[2] 11-19				
	C4casim	[2] 19-33				
	IIC5ca	33-43	Coarse sand	26.7	38.2	11.2
	IIC6	43-50	Coarse sand	27.2	42.6	11.0
Belted sandy loam: *Location:* Penoyer Valley. (*Survey No.* 59-Nev-9-36-1 to 9-36-7; *Laboratory No.* 59820-59826.)	A1	0-3	Coarse sandy loam	11.3	21.3	11.3
	B2t	3-7	Sandy clay loam	4.4	13.4	10.8
	C1sicam	[3] 7-11				
	C2	11-24	Sandy loam	7.4	16.6	12.9
	C3	24-32	Fine sandy loam	4.7	10.6	10.9
	IIC4	32-40	Loam	2.3	5.4	4.8
	IIC5	40-60	Silt loam	.5	2.6	1.8

See footnotes at end of table.

The Monte Cristo and Tippipah soils have a moderately fine textured B2t horizon, and the Monte Cristo soils are mottled in the substratum below a depth of 40 inches. In other respects, the soils of these two series are similar to the Tickapoo soils. (Laboratory data for a typical Tippipah soil are given in tables 9 and 10.)

Typic Haplaquolls: The Ash Springs soils, heavy subsoil variant, and the Pahranagat soils are in this subgroup. They are poorly drained or somewhat poorly drained, stratified, fine-textured or silty soils that developed on nearly level flood plains and basins.

The Pahranagat soils are representative of this subgroup. These soils are erratically stratified, medium textured to fine textured, and silty. In addition, their profile includes an occasional, thin layer of muck or of mucklike material. Typically, the Pahranagat soils have a grayish-brown or gray A1 horizon; they contain high-chroma mottles in the lower A and the C horizons; and they are calcareous.

The Ash Springs soils, heavy subsoil variant, are similar to the Pahranagat soils in most respects, but their weighted average texture in the 10- to 40-inch section of the profile contains more than 35 percent clay.

Laboratory Data

Tables 9 and 10 show the results of physical and chemical analyses of six soils mapped in the Pahranagat-Penoyer Area.

Standard methods were used to obtain the data in tables 9 and 10. Determinations of particle size distribution were made by the pipette method. The reaction was measured with a Beckman glass electrode. Determinations of electrical conductivity, soluble cations and anions, cation exchange capacity, and moisture retention were made by methods described in USDA Handbook No. 60 (*10*). Organic carbon was determined by heat of dilution as described in USDA Circular 757 (*6*). Total nitrogen was determined by the AOAC (Association of Official Agricultural Chemists) Kjeldahl method. Extractable cations were determined by methods described in USDA Circular 757. Sodium and potassium in the saturation extract were analyzed through the use of a Beckman flame spectrophotometer. Calcium and magnesium were determined by methods described in USDA Handbook No. 60. The $CaCO_3$ equivalent was determined by adoption of a modified Parsons method.

for six representative soils

Service, Riverside, Calif. Dashes indicate values not determined]

Particle-size distribution—Continued							Soil moisture held at tension of 15 atmospheres	Moisture at saturation
				Other size classes				
Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay <(0.002 mm.)	0.2 to 0.02 mm.	0.02 to 0.002 mm.	Larger than 2 mm.		
Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
3. 7	6. 4	57. 0	31. 4	36. 2	29. 7	0	24. 7	54. 8
11. 1	12. 6	62. 8	10. 8	56. 3	26. 8	0	16. 5	58. 8
30. 2	15. 4	30. 0	10. 6	49. 1	15. 0	2	10. 6	47. 7
25. 4	22. 0	32. 1	9. 3	59. 0	12. 9	2	12. 3	55. 9
24. 2	11. 5	23. 0	8. 3	41. 5	7. 5	14	7. 7	32. 6
27. 5	16. 2	20. 4	7. 1	48. 3	5. 7	12	6. 4	31. 8
11. 5	4. 3	8. 5	2. 8	15. 3	2. 5	9	3. 3	19. 8
16. 6	6. 2	15. 3	7. 2	21. 8	7. 1	5	5. 2	17. 8
12. 4	3. 9	11. 0	14. 8	14. 2	6. 0	5	9. 2	23. 0
10. 4	3. 0	6. 7	3. 8	10. 5	4. 0	10	5. 2	30. 2
8. 7	2. 4	5. 6	2. 5	9. 2	2. 9	10	4. 5	30. 8
20. 0	9. 1	16. 8	10. 2	23. 7	13. 6	3	6. 3	16. 5
22. 6	10. 3	17. 7	24. 8	50. 3	10. 1	2	14. 9	25. 7
25. 4	13. 2	16. 0	8. 5	34. 6	10. 0	6	6. 3	23. 3
27. 6	13. 1	24. 2	8. 9	37. 8	16. 4	2	7. 0	24. 3
14. 6	12. 0	44. 7	16. 2	31. 5	34. 4	1	14. 8	44. 0
7. 3	9. 2	54. 1	24. 5	25. 5	42. 9	0	22. 3	51. 0

TABLE 9.—*Physical data for six*

Soil	Horizon	Depth	Textural Class	Particle-size distribution		
				Very coarse sand (2.0 to 1.0 mm.)	Coarse sand (1.0 to 0.5 mm.)	Medium sand (0.5 to 0.25 mm.)
		Inches		*Percent*	*Perecnt*	*Percent*
Fang fine sandy loam:						
Location: Penoyer Valley.	A1	0–3	Fine sandy loam	2.4	10.4	12.3
(*Survey No.* 59–Nev–9–37–1	C1	3–13	Fine sandy loam	2.5	7.2	9.2
to 9–37–7; *Laboratory No.*	C2	13–20	Fine sandy loam	1.4	7.3	8.2
59827–59833.)	C3	20–39	Fine sandy loam to loam	1.8	7.4	7.8
	IIC4	39–45	Gravelly loamy coarse sand.	16.2	21.8	8.4
	IIIC5	45–57	Loam	6.5	10.2	2.8
	IVC6	57–64	Coarse sandy loam	18.8	19.8	7.0
Tickapoo loam:						
Location: Penoyer Valley. (*Survey No.* 59–Nev–9–40–1 to 9–40–9; *Laboratory No.* 59850–59858).	A1	0–3	Gravelly coarse sandy loam to gravelly loamy coarse sand.	12.2	21.4	12.8
	B1t	3–5	Sandy clay loam	8.5	17.6	12.0
	B21t	5–11	Sandy clay	7.3	14.9	11.0
	B22t	11–17	Sandy clay	6.8	14.8	10.5
	IIC1sica	17–22	Gravelly coarse sandy loam.	13.1	25.3	12.0
	IIIC2si	22–44	Gravelly coarse sand	16.0	32.1	20.4
	IIIC3sica	44–50	Very gravelly coarse sand.	11.3	40.3	19.2
	IIIC4	50–60	Gravelly coarse sand	16.0	46.6	19.9
	IIIC5sicam	60–64	Very gravelly coarse sand.	10.6	45.3	18.7
Tippipah sandy loam:						
Location: Penoyer Valley.	A	0–4	Loamy sand	3.7	19.3	16.6
(*Survey No.* 59–Nev–9–35–1	A&B	4–8	Loam	1.4	10.2	10.4
to 9–35–9; *Laboratory No.*	B21t	8–18	Sandy clay loam	2.9	14.6	10.0
59811–59819).	B22t	18–24	Gravelly sandy clay loam.	2.9	16.7	14.3
	B3t	24–28	Gravelly coarse sandy loam.	5.9	24.9	18.0
	C1si	28–44	Gravelly loamy coarse sand.	9.1	20.8	18.0
	IIC2sica	44–49	Gravelly loamy coarse sand.	9.4	23.1	17.4
	IIC3si	49–55	Gravelly coarse sand to gravelly loamy coarse sand.	22.1	28.4	15.3
	IIC4	55–65	Gravelly coarse sand	15.2	37.4	22.2

[1] Hardpan.
[2] Hardpan indurated with lime and silica.

representative soils—Continued

Particle-size distribution—Continued							Soil moisture held at tension of 15 atmospheres	Moisture at saturation
Fine sand (0.25 to 0.10 mm.)	Very fine sand (0.10 to 0.05 mm.)	Silt (0.05 to 0.002 mm.)	Clay <(0.002 mm.)	Other size classes				
				0.2 to 0.02 mm.	0.02 to 0.002 mm.	Larger than 2 mm.		
Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
33. 4	12. 6	18. 4	10. 5	39. 7	12. 1	4	7. 4	24. 3
34. 0	14. 3	19. 6	13. 2	44. 0	11. 9	5	8. 9	27. 3
30. 4	13. 2	25. 2	14. 3	41. 7	16. 9	4	10. 2	32. 7
23. 0	12. 9	35. 5	11. 6	41. 4	22. 2	6	9. 8	33. 7
25. 6	11. 1	8. 5	8. 4	32. 3	3. 4	49	5. 4	23. 2
5. 7	6. 2	48. 4	20. 2	20. 5	37. 9	5	12. 9	38. 3
13. 1	15. 5	17. 1	8. 7	36. 7	4. 4	11	5. 0	22. 7
16. 2	10. 7	21. 9	4. 8	29. 2	12. 1	16	4. 3	14. 9
13. 1	6. 0	17. 2	25. 6	17. 4	12. 2	7	9. 8	23. 5
11. 1	3. 4	9. 3	43. 0	11. 1	6. 5	9	19. 3	45. 2
11. 2	4. 1	11. 4	41. 2	13. 6	7. 2	20	19. 5	46. 9
13. 4	5. 8	14. 7	15. 7	17. 6	9. 5	40	11. 8	41. 3
17. 0	3. 4	5. 4	5. 7	13. 1	2. 9	38	5. 5	27. 2
15. 2	3. 7	5. 3	5. 0	12. 8	2. 9	50	5. 9	38. 9
13. 4	1. 0	1. 1	2. 0	6. 2	1. 0	33	3. 0	28. 3
12. 7	3. 5	3. 6	5. 6	10. 8	1. 6	50	7. 1	41. 0
28. 7	15. 2	12. 3	4. 2	37. 5	6. 0	10	3. 2	20. 9
15. 2	7. 5	40. 2	15. 1	26. 4	29. 2	15	7. 1	18. 5
14. 0	4. 4	25. 5	28. 6	14. 9	21. 8	10	15. 8	44. 0
19. 4	5. 5	17. 1	24. 1	17. 9	14. 4	20	12. 4	38. 2
24. 7	6. 4	8. 1	12. 0	20. 9	5. 7	33	9. 5	32. 2
28. 7	9. 0	7. 8	6. 6	27. 8	4. 4	20	5. 5	28. 2
27. 8	7. 0	9. 8	5. 5	24. 5	6. 6	32	5. 7	32. 3
18. 0	3. 9	8. 0	4. 3	14. 1	6. 3	38	4. 9	26. 9
17. 0	2. 3	2. 4	3. 5	9. 4	2. 1	26	3. 3	25. 1

[3] Strongly cemented duripan.

TABLE 10.—*Chemical data for*

[Analyses made at Soil Survey Laboratory, Soil Conservation

Soil	Horizon	Depth	Reaction		Organic matter			$CaCO_3$ equivalent	Electrical conductivity (millimhos per centimeter at 25° C.)
			Saturated paste	1:10	Organic carbon	Nitrogen	C/N ratio		
		Inches	*pH*	*pH*	*Percent*	*Percent*		*Percent*	
Adaven loam:									
Location: Pahranagat Valley. (*Survey No.* 59–Nev–9–30–1 to 9–30–7; *Laboratory No.* 59773–59779.)	A1	0–2	8.5	9.0	3.09	0.203	15.2	13	125.0
	C1	2–11	8.4	9.3	1.27	.104	12.2	13	23.8
	C2ca	11–16	8.7	9.3	.56	.044	12.7	13	2.5
	C3ca	16–24	8.4	8.9	.39	.032	12.2	9	1.1
	C4cam	24–39	8.2	8.7	.20			16	[2]
	C5	39–50	8.3	8.8	.08			8	.7
	C6	50–60	8.0	8.7	.12			6	1.0
Alko loamy coarse sand:									
Location: Pahranagat Valley. (*Survey No.* 59–Nev–9–32–1 to 9–32–7; *Laboratory No.* 59787–59793.)	A1	0–1	8.3	8.6	.08	.012		3	.4
	C1	1–4	8.3	8.8	.08	.014		7	.3
	C2	4–11	8.3	8.8	.17	.028		8	.3
	C3sicam	11–19	8.4	8.8	.21	.028		24	[3]
	C4casim	19–33	8.7	9.3	.06			14	[3]
	IIC5ca	33–43	8.5	9.2	.04			6	2.3
	IIC6	43–50	8.0	8.9	0			1	3.5
Belted sandy loam:									
Location: Penoyer Valley. (*Survey No.* 59–Nev–9–36–1 to 9–36–7; *Laboratory No.* 59820–59826.)	A1	0–3	8.2	9.2	.17	.023		2	1.0
	B2t	3–7	8.1	9.1	.28	.036	7.8	[4]	.6
	C1sicam	7–11	8.3	9.2	.22	.023		1	[5]
	C2	11–24	8.6	9.3	.04			[4]	.5
	C3	24–32	8.1	9.4	.02			[4]	2.8
	IIC4	32–40	7.5	8.8	.09			1	12.9
	IIC5	40–60	7.3	8.3	.07			1	18.7
Fang fine sandy loam:									
Location: Penoyer Valley. (*Survey No.* 59–Nev–9–37–1 to 9–37–7; *Laboratory No.* 59827–59833.)	A1	0–3	8.0	8.9	.28	.033	8.5	[4]	4.6
	C1	3–13	8.0	8.9	.22	.027		1	.4
	C2	13–20	8.1	8.8	.21	.026		2	.4
	C3	20–39	8.0	9.0	.21	.027		2	.9
	IIC4	39–45	7.6	8.4	.06			1	12.4
	IIIC5	45–57	7.3	8.0	.14			1	18.6
	IVC6	57–64	7.3	8.0	.04			[4]	14.0
Tickapoo loam:									
Location: Penoyer Valley. (*Survey No.* 59–Nev–9–40–1 to 9–40–9; *Laboratory No.* 59850–59858.)	A1	0–3	8.1	9.0	.09	.017		[4]	.6
	B1t	3–5	7.5	8.6	.09	.021		[4]	.5
	B21t	5–11	7.5	8.8	.28	.038	7.4	[4]	.8
	B22t	11–17	8.1	9.2	.35	.041	8.5	4	1.4
	IIC1sica	17–22	8.0	9.2	.26	.031	8.4	16	2.6
	IIIC2si	22–44	7.8	8.9	.06			6	5.3
	IIIC3sica	44–50	7.8	8.6	.11			14	5.4
	IIIC4	50–60	7.9	8.9	0			1	4.0
	IIIC5sicam	60–64	7.6	8.1	.21			14	5.3
Tippipah sandy loam:									
Location: Penoyer Valley. (*Survey No.* 59–Nev–9–35–1 to 9–35–9; *Laboratory No.* 59811–59819.)	A	0–4	8.2	9.0	.18	.021		[4]	1.0
	A&B	4–8	8.0	9.3	.16	.022		1	1.1
	B21t	8–18	8.2	9.4	.31	.040	7.8	2	2.2
	B22t	18–24	7.9	9.2	.14			1	7.8
	B3t	24–28	7.6	7.9	.09			1	13.2
	C1si	28–44	7.8	8.1	.03			2	11.1
	IIC2sica	44–49	7.8	8.1	.08			7	11.0
	IIC3si	49–55	7.8	8.6	.03			5	11.0
	IIC4	55–65	8.0	9.2	0			[4]	6.0

[1] Exchangeable Na or K extracted with NH_4OAc; less that in saturation extract.
[2] Hardpan.
[3] Hardpan indurated with lime and silica.

six representative soils

Service, Riverside, Calif. Dashes indicate values not determined]

Saturation extract (soluble)									Free Fe_2O_3	Cation exchange capacity (Na)	Extractable cations			Exchangeable Na
Cations				Anions							[1] Na	H	[1] K	
Na	K	Ca	Mg	Cl	CO_3	HCO_3	SO_4	NO_3						
Meq./l.	*Meq./l.*	*Meq./l.*	*Meq./l.*	*Meq./l.*	*Meq./l.*	*Meq./l.*	*Meq./l.*	*Meq./l.*	*Percent*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Percent*
2,550.0	185.0	105.9	79.8	485.8	0	13.9	1,389.0	0.60	0.2	31.8	10.5	------	8.5	33
218.8	35.0	4.4	14.3	161.1	0	9.3	74.5	.60	.4	29.2	11.3	------	1.6	39
19.6	3.4	1.4	1.5	7.2	0	7.8	6.3	.04	.3	24.8	3.8	------	2.1	15
7.4	1.1	2.0	.7	3.7	0	5.7	3.6	.07	.3	22.7	1.9	------	3.6	8
(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	------	(2)	(2)
4.5	.5	2.2	1.0	.5	0	2.9	1.8	.02	.4	15.9	2.6	------	1.7	5
4.7	.6	3.5	1.2	1.2	0	2.7	5.4	.05	.3	15.5	1.1	------	1.6	7
.6	.2	2.9	.2	<.1	0	3.4	.3	.08	1.2	5.2	.2	------	.3	4
1.1	.5	2.3	.4	<.1	0	2.5	.3	.13	1.7	5.6	.4	------	.2	7
1.8	.9	1.7	.5	.1	0	1.6	.2	.16	1.0	14.1	.3	------	1.2	2
(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	15.6	(3)	------	(3)	(3)
(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	13.1	(3)	------	(3)	(3)
19.5	.2	1.5	.6	9.9	0	2.5	7.3	.07	.3	9.3	2.4	------	.4	26
24.5	1.0	7.1	2.6	10.7	0	1.2	24.3	.04	.4	7.3	1.7	------	.4	23
6.4	1.5	3.1	.2	2.9	0	6.3	--------	.59	.4	19.4	1.0	------	3.9	5
3.4	1.2	1.9	.1	.5	0	4.3	--------	.82	.4	27.8	1.5	------	6.9	5
(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	20.3	(5)	------	(5)	(5)
8.4	.9	2.1	0	.5	0	4.0	1.2	.20	.4	17.4	2.3	------	4.2	13
22.0	.5	3.2	0	20.5	0	2.6	2.1	.14	.5	20.6	5.5	------	2.7	27
87.5	.7	34.9	6.5	110.4	0	2.1	13.0	.04	.7	33.3	9.5	------	2.5	28
106.0	3.1	30.1	4.0	18.0	0	3.3	--------	.05	1.1	40.1	10.8	------	2.0	27
21.0	2.2	31.8	0	26.5	0	3.6	.3	.84	.7	24.1	<.1	------	4.3	<1
.9	.9	2.5	.2	1.0	0	3.3	.4	.91	.7	25.4	.2	------	3.4	<1
1.4	.1	2.6	.5	2.7	0	3.8	.3	.32	.7	30.0	.9	------	1.0	3
4.3	<.1	4.8	.2	2.9	0	3.3	.5	4.35	.8	28.8	2.0	------	.4	7
26.3	.1	106.7	2.5	20.2	0	1.8	15.6	71.0	.7	16.2	1.3	------	.3	8
27.5	.2	170.3	6.2	30.1	0	2.1	22.1	116.0	.7	34.4	2.8	------	.6	20
24.4	.3	129.1	1.5	24.1	0	1.3	19.9	74.0	.8	12.3	1.3	------	.6	11
3.5	.9	2.3	0	.5	0	4.0	--------	.83	.8	13.4	.8	------	2.5	6
3.9	.5	.8	.8	.5	0	2.7	--------	--------	.9	22.8	1.7	0.7	3.9	7
5.9	.6	1.4	.4	2.9	0	4.4	1.2	.60	.7	34.3	3.0	1.0	4.0	9
10.3	.9	2.7	.7	8.2	0	3.5	1.9	.76	.6	33.0	3.3	------	4.3	10
18.0	1.1	5.1	.8	14.8	0	2.6	6.0	.68	.3	25.5	2.6	------	1.8	10
13.0	.5	24.4	2.1	19.0	0	1.8	40.6	.38	.5	11.6	2.0	------	1.7	17
27.5	.8	31.0	2.4	20.1	0	1.4	34.4	.54	.1	11.3	2.1	------	1.5	19
23.8	.8	20.7	1.2	12.5	0	1.3	28.3	.37	.4	7.7	1.3	------	1.0	17
26.3	1.0	31.5	7.3	22.6	0	1.7	45.6	.39	.9	10.0	1.6	------	1.2	16
3.7	1.7	5.0	.2	1.4	0	8.3	.8	.35	.7	10.6	.5	.1	2.2	5
8.1	1.3	2.0	0	3.2	0	6.9	--------	.35	1.1	18.7	2.1	------	5.2	11
19.3	.7	2.7	.1	13.3	0	8.2	1.3	.28	.6	34.6	7.9	------	4.5	23
62.5	1.0	12.5	0	63.7	0	17.1	6.1	.04	.6	27.4	7.7	------	2.9	28
100.0	1.3	42.7	0	90.0	0	2.7	42.9	.04	.4	21.5	5.5	------	2.3	26
81.8	1.3	32.6	1.0	62.5	0	1.9	50.5	.03	.5	15.0	4.7	------	1.9	31
86.3	1.4	32.7	1.6	56.5	0	2.9	51.6	.03	.4	17.0	5.1	------	2.3	30
86.3	1.8	29.9	4.7	61.3	0	2.7	53.4	.08	.3	14.1	4.4	------	2.0	31
47.0	1.1	4.6	1.2	17.3	0	.6	7.5	.08	.5	9.7	3.2	------	1.7	33

[4] Trace.
[5] Strongly cemented duripan.

General Nature of the Areas

This section is primarily for those who are not familiar with the Pahranagat-Penoyer Areas. It discusses climate, settlement and development, transportation, and agriculture.

Climate [3]

The Pahranagat and Penoyer Valleys have a semiarid, continental climate. Sunshine is abundant, precipitation is low, the rate of evaporation is high, and the air is dry and clear. In summer the days are hot but the nights are cool. Winters are fairly cold. Table 11 gives temperature and precipitation data compiled from records of the United States Weather Bureau at Alamo.

The location of the valleys on a plateau between two major mountain ranges accounts in large part for the semiarid climate. To the west lie the Sierra Nevada, a massive range of mountains that effectively reduces the moisture content of storms moving inland from the Pacific Ocean during fall, winter, and spring. As moist air, in its easterly flow, is forced to rise over the mountains, it loses much of its moisture on the western slopes. The air moving down the eastern slopes is warmed by compression and, when it reaches the interior valleys, is relatively dry. As the air continues to move eastward, each successive mountain further reduces the moisture content and is a contributing reason for the light precipitation in the Pahranagat and Penoyer Valleys.

[3] E. Arlo Richardson, State climatologist, U.S. Weather Bureau, prepared this subsection.

The average annual precipitation in these valleys is about 6.5 inches. This amount is not enough for producing crops without irrigation. Of the total yearly precipitation, about 40 percent comes in winter and early in spring, and a large percentage falls during showers and thunderstorms in July and August. The most rainfall recorded in a 24-hour period is 3.45 inches, which fell in August. The highest annual precipitation reported is 14.91 inches, and the lowest, 1.23 inches. Because the annual precipitation varies so widely, periods of drought can be severe, even if supplemental water from the surrounding mountains is used to meet the needs of crops.

Snowfall in the valleys is light, about 10 inches annually. Its yearly total is rarely more than 2 feet, though the maximum annual snowfall for the period of record is about 3 feet.

Thunderstorms occur on an average of about 20 days in a year. Heavy rains are rare, but at times more than 1 inch of rain falls during a heavy shower. Hail that accompanies a thunderstorm in summer does little damage because the hailstones are generally small.

In the Pahranagat Valley the average daily range in temperature is great. It averages nearly 29° F. in December and January and 42° in summer. The highest temperature observed during the period of record is 115°, and the lowest, −9°.

In the Penoyer Valley, where no data are available, the temperatures likely are a little lower than they are in the Pahranagat Valley. Penoyer Valley is the higher of the two in elevation, and in winter it receives cold air that flows down the slopes of surrounding mountains and is trapped in the lower valley.

Table 11.—*Temperature and precipitation at Alamo, Pahranagat Valley, Nev.*

Month	Temperature				Precipitation			
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than—	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than—	Average monthly total	One year in 10 will have— Less than—	One year in 10 will have— More than—	Average depth of snow on days with snow cover
	° F.	° F.	° F.	° F.	Inches	Inches	Inches	Inches
January	50.4	21.4	66	8	0.66	0.01	1.59	4.7
February	55.6	25.5	71	12	.69	.01	1.50	1.2
March	63.5	30.8	77	20	.67	.01	1.82	.8
April	74.9	38.0	88	29	.57	.01	1.43	.1
May	83.5	43.9	96	33	.45	.01	1.65	0
June	92.7	50.9	105	40	.15	.01	.62	0
July	100.4	58.6	108	47	.71	.01	1.86	0
August	97.4	57.1	106	45	.69	.01	1.65	0
September	91.2	48.8	101	37	.31	.01	.70	(1)
October	78.5	39.2	91	30	.51	.01	1.14	0
November	64.6	29.6	79	18	.45	.01	.98	.2
December	54.0	24.7	68	13	.63	.01	1.43	2.8
Year	75.6	39.0	----	----	6.49	----	----	9.8

[1] Trace.

Tornadoes are virtually unknown in the two valleys, and they are extremely rare in Nevada. Only one tornado has been reported in the State since 1916, though funnel clouds are sometimes seen during heavy thunderstorms.

In the Pahranagat Valley the average growing season, or frost-free period, extends from the first of May to the middle of October, a period of about 5½ months. Frost has occurred, however, as late as June 11 and as early as September 12. Table 12 gives data on the probability of freezing temperatures in spring and in fall at Alamo.

In the Penoyer Valley the estimated frost-free period, or average growing season, is about 5 months.

No records of wind velocity have been kept in either valley, but weather maps and the general relief indicate that winds generally are light to moderate and that the average velocity is less than 20 miles per hour. Occasionally there are strong winds that accompany local thundershowers in the warmer months or active frontal systems in fall, winter, and spring. The flow of air in the Pahranagat Valley generally is either northward or southward because of the constraining influence of the surrounding mountains. For the same reason, the wind likely is stronger in this valley than in the more open Penoyer Valley.

Settlement and Development

The first settlement in the Pahranagat Valley was in the vicinity of Hiko Spring. The first settlers, attracted by mining on Irish Mountain, established a community in about 1850. Shortly thereafter, a mining community was established on the Worthington Range near the Penoyer Valley. Both of these settlements were later abandoned. Mining ceased as an industry around 1900 and, in Pahranagat Valley, gradually gave way to ranching. At the present time, the only community in the Areas is Alamo, located on U.S. Highway 93 in the Pahranagat Valley.

Electricity is available only in the Pahranagat Valley. Also in this valley are grocery stores, gasoline stations, churches, schools, and motels. Similar facilities are not available in the Penoyer Valley.

Transportation

Trucking is the major means of transporting produce and livestock in the Pahranagat-Penoyer Areas. U.S. Highway 93, a paved road that connects Las Vegas and Ely, affords adequate access to the Pahranagat Valley. State Route 25 crosses the lower part of the Penoyer Valley. It also is paved and is a connecting link between U.S. Highway 6, northwest of the valley, and Crystal Spring in the Pahranagat Valley. In addition, there are gravel roads that provide access to most parts of both Areas.

The nearest shipping point on a railroad is Caliente, 56 miles northeast of Alamo. Caliente is on a main line of the Union Pacific Railroad.

Air travel is limited to light aircraft, for only a small airstrip is located near Alamo.

Agriculture

Farming and the raising of livestock are the major agricultural enterprises. Most of the livestock raising is of the range type, but there are some dairy farms in the Pahranagat Valley. About 6,100 acres are farmed. This acreage is used for producing native meadow for hay and pasture, alfalfa, grass, clover, and small grain, as well as for corn and other row crops suited to the Areas. Some of the farms also are used for recreational hunting.

TABLE 12.—*Probability of last freezing temperature in spring and first in fall*

[Estimates are for Alamo, Pahranagat Valley]

Probability	Dates for given probability and temperature				
	16° F. or less	20° F. or less	24° F. or less	28° F. or less	32° F. or less
Spring:					
1 year in 10 later than	------------	------------	April 25	May 22	June 2
25 years in 100 later than	March 30	March 31	April 8	April 30	May 5
5 years in 10 later than	March 9	March 16	March 26	April 18	April 27
Fall:					
1 year in 10 earlier than	November 11	October 25	October 21	September 26	September 21
25 years in 100 earlier than	November 17	November 6	October 29	October 15	September 30
5 years in 10 earlier than	November 25	November 16	November 6	October 26	October 15

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Glossary

Acre-foot. The quantity of water that will cover 1 acre 1 foot deep.

Alkali soil. A soil that has so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or higher), or both, that the growth of most crop plants is reduced.

Alluvium. Soil materials deposited on land by streams.

Atmosphere (soils). The unit commonly used to express soil moisture tension, or the force per unit area that must be exerted to remove water from soil. One atmosphere equals 14.71 pounds per square inch.

Available water capacity. The total quantity of water that will not drain away, but can be taken up by plant roots within the root zone, or to a depth of 5 feet, whichever is less. The ratings are (1) *high,* more than 7.5 inches; (2) *moderate,* 5.0 to 7.5 inches; (3) *low,* 2.5 to 5.0 inches; and (4) *very low,* less than 2.5 inches.

Border irrigation. A method of irrigation in which the lateral surface flow of water is controlled with small earth ridges called border dikes.

Bulk density. The mass or weight of oven-dry soil per unit bulk volume, including air space.

Capillary water. The part of soil water held by cohesion as a continuous film around the particles of soil and in the capillary spaces. Most of this water is available to plants.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, magnesium, sodium, potassium, and hydrogen.

Cation-exchange capacity. A measure of the total amount of exchangeable cations that can be held by the soil. It is expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7) or at some other stated pH value. The term as applied to soils is synonymous with base exchange capacity but is more precise in its meaning.

Chlorosis. A condition in plants resulting from the failure of chlorophyll (the green coloring matter) to develop, generally because of deficiency of an essential nutrient. Leaves of chlorotic plants range from light green through yellow to almost white.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Some of the terms commonly used to describe consistence are—

Loose.—Noncoherent; soil does not hold together in a mass.

Friable.—When moist, soil crushes easily under gentle pressure between thumb and forefinger and can be pressed together in a lump.

Firm.—When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, soil is readily deformed by moderate pressure but can be pressed into a lump; forms a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, soil adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, soil moderately resistant to pressure but is difficult to break between thumb and forefinger.

Compact.—A combination of firm consistence and close packing or arrangement of soil particles.

Control section. That part of a soil profile containing the horizons that determine the placement of the soil in the new system of soil classification. Generally, these horizons are between a depth of 10 inches and a depth of 40 inches.

Corrugation irrigation. A method of irrigating by using corrugations, or shallow furrows, that run downslope; used for applying water to hay, small grain, and other close-growing crops.

Cubic foot per second. A unit of flow commonly used in measuring water; a cubic foot of water moving 1 foot in 1 second. Approximately 450 gallons per minute equals 1 cubic foot per second (c.f.s.). One c.f.s. flowing 1 hour equals 1 acre-inch.

Depth, effective soil. The depth of soil material that plant roots can penetrate readily to obtain water and nutrients. It is the depth to a layer that, in physical or chemical properties, differs from the overlying material to such extent as to prevent or seriously retard the growth of roots. The depth classes are: (1) *very deep,* more than 60 inches; (2) *deep,* 36 to 60 inches; (3) *moderately deep,* 20 to 36 inches; (4) *shallow,* 10 to 20 inches; and (5) *very shallow,* 0 to 10 inches.

Dispersion. Deflocculation of the soil and its suspension in water.

Durinode. A durinode is a weakly cemented to indurated nodule that breaks down in concentrated KOH after treatment with HCl to remove carbonates, but that does not break down on treatment with concentrated HCl alone. The cement is SiO_2, presumably opal and microcrystalline forms of silica. A dry durinode does not slake in water. It is firm to extremely firm, and brittle when wet, both before and after acid treatment. Durinodes range upward in size from about 1 centimeter.

Electrical conductivity. The property of allowing transfer of electrical charge. The reciprocal of the electrical resistivity. The resistivity is the resistance in ohms of a conductor that is 1 centimeter long and has a cross-sectional area of 1 square centimeter. Hence, electrical and conductivity is expressed in reciprocal ohms per centimeter, or mhos per centimeter.

Eolian deposits. Wind-deposited materials moved fairly short distances and accumulated in dunes; generally, coarse textured.

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Erosion pavement. A cover of small and large rock fragments left on the surface of the soil after finer particles have been removed from surface horizons by wind.

Evapotranspiration. The loss of water from a soil by evaporation and plant transpiration.

Exchangeable sodium. Sodium that is attached to the surface of soil particles and can be replaced by calcium, magnesium, and other positively charged ions, or cations, in the soil solution.

Exchangeable-sodium percentage. The degree to which the exchange complex of the soil is saturated with sodium.

Fertility, soil. In this survey, the capacity of a soil to respond to chemical and organic fertilizers. Relative terms are—

Low.—Soil has low cation-exchange capacity or is shallow and does not readily respond to plant nutrients added in large amounts.

Medium.—Soil has medium cation-exchange capacity or is moderately deep and readily responds to plant nutrients added in large amounts.

High.—Soil is deep, has high cation-exchange capacity, and readily responds to plant nutrients added in large amounts.

Flood plain. Nearly level land along streams that overflow during floods.

Furrow irrigation. A method of irrigating by using small ditches, or furrows, to apply water to crops planted in rows.

Ground water. Water that fills all the unblocked pores of the material underlying the water table, which is the upper limit of saturation. It is the gravitational, or free, water in a zone of saturation. The source of water for wells and springs.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon. The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon. The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and it is therefore marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon. The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused by accumulation of clay, sesquioxides, humus, or some combination of these characteristics. The combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon. The weathered rock material immediately beneath the solum. This layer, commonly called the soil parent material, is presumed to be like that from which the overlying horizons were formed in most soils. If the underlying material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer. Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Ignimbrite. A type of silicic volcanic rock forming thick, massive, compact, lavalike sheets. The rock is chiefly a fine-grained rhyolitic tuff formed mainly of glass particles in which crystals of feldspar, quartz, and occasionally hypersthene or hornblende are embedded.

Infiltration. The downward entry of water into the soil. The rate of infiltration is defined as the volume of water passing into soil per unit of area per unit of time.

Intake rate, average. The average rate, generally expressed in inches per hour, at which rain or irrigation water enters the soil.

Lacustrine deposits. Material that has been deposited in lake water and then exposed when the water level lowered or the land rose.

Leaching. The removal of material in solution by water passing through the soil.

Moisture tension. The force at which water is held by soil, usually expressed as the equivalent of a unit column of water in centimeters; 1,000 cm. of water is equivalent to 1 atmosphere tension. Moisture tension indicates the force required to free moisture from soil particles so that it can be used by plants. The force increases with dryness.

Micro-organisms. Forms of life that are either too small to be seen with the unaided eye or are barely discernible.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.*

Oxidation. A chemical change in which oxygen or its chemical equivalent is added to an element or a compound.

Parent material, soil. The horizon of weathered rock or partly weathered soil material from which soil has formed.

Permeability. The quality of a soil horizon that enables water or air to move through it. The permeability classes are (1) *very slow,* less than 0.05 inch per hour; (2) *slow,* 0.05 to 0.20 inch per hour (3) *moderately slow,* 0.20 to 0.80 inch per hour; (4) *moderate,* 0.80 to 2.50 inches per hour; (5) *moderately rapid,* 2.50 to 5.0 inches per hour; (6) *rapid,* 5.0 to 10.0 inches per hour; and (7) *very rapid,* more than 10.0 inches per hour.

pH. A numerical designation of the acidity or alkalinity of a soil. The neutral point is pH 7.0. All pH values below 7.0 indicate acidity, and all above 7.0 indicate alkalinity.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Pyroclastic (geology). Formed by fragmentation as a result of volcanic or igneous action.

Root zone. The part of the soil that is penetrated, or can be penetrated, by plant roots.

Saline soil. A soil that contains soluble salts in a quantity large enough to impair growth of crops but that does not contain excessive exchangeable sodium.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and is highly alkaline; or contains harmful salts and exchangeable sodium and is strongly alkaline. The salts, exchangeable sodium, and alkalinity occur in the soil in such location that the growth of most crops is less than normal.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Saturation extract. The solution extracted from a soil paste that has been saturated by adding water while stirring.

Shrink-swell potential. Amount that a soil will expand when wet or contract when dry. Indicates kinds of clay in soil.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Structure, soil. The arrangement of primary soil particles into compound particles, or clusters, that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*blocky, columnar, granular, platy,* and *prismatic. Structureless* soils are *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Angular blocky.—Aggregates are shaped like blocks; they may have flat or rounded surfaces that join at sharp angles.

Subangular blocky.—Aggregates have some rounded and some flat surfaces; upper sides are rounded.

Columnar.—Aggregates are prismatic and are rounded at the top.

Granular.—Aggregates are roughly spherical, small, and relatively nonporous, but they do not have the distinct faces of blocky structure.

Platy.—Aggregates are flaky or platelike.

Prismatic.—Aggregates have flat vertical surfaces, and their height is greater than their width.

Subsoil. In many soils, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer beneath the solum, or true soil. It applies to the parent material and to layers unlike the parent material that lie below the B horizon, or subsoil.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geology). A nearly level or undulating plain that commonly is rather narrow, generally has a steep front, and borders a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam; loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water quality. A classification of irrigation water based on the electrical conductivity and the sodium-adsorption ratio. Described in terms of *excellent, good, fair,* and *poor.*

Water table, main. The upper surface of free ground water below which all pores are completely filled with water.

Water table, perched. The upper surface of a body of free ground water that is separated from an underlying body of ground water by unsaturated material.

GUIDE TO MAPPING UNITS

[For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs.

[See subsection beginning on p. 72 for descriptions of wildlife sites. See table 1, p. 9, for the approximate acreage and proportionate extent of the soils, and table 3, p. 69, for estimated yields. See subsection beginning on p. 73 for engineering uses of soils]

Map symbol	Mapping unit	Described on page	Capability units: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Wildlife site Number
Ad	Adaven loam	11	VIw-6	67	-------	--	9
AkB	Alko loamy coarse sand, 0 to 8 percent slopes	12	-------	--	VIIs-8	68	--
AlB	Alko stony loamy coarse sand, 0 to 8 percent slopes	12	-------	--	VIIs-8	68	--
AmB	Alko-Tickapoo-Rock land association, 2 to 8 percent slopes	13					
	Alko gravelly loam, 2 to 4 percent slopes	--	-------	--	VIIs-8	68	--
	Tickapoo stony sandy loam, 2 to 8 percent slopes	--	-------	--	VIIs-4	67	--
	Rock land	--	-------	--	VIIIs-7	69	--
An	Ash Springs fine sandy loam, somewhat poorly drained	14	IIw-69	62	VIIw-6	67	7
Ao	Ash Springs silt loam	14	IIIw-69P	65	-------	--	7
Ap	Ash Springs silt loam, somewhat poorly drained	14	IIw-69	62	-------	--	7
Ar	Ash Springs silt loam, reclaimed	14	IIw-9	63	-------	--	6
As	Ash Springs silty clay loam	14	IIIw-69P	65	-------	--	7
At	Ash Springs silt loam, heavy subsoil variant, somewhat poorly drained	15	IIw-9	63	-------	--	7
Au	Ash Springs silt loam, heavy subsoil variant, slightly saline	15	IVw-369P	67	-------	--	7
Av	Ash Springs silty clay loam, heavy subsoil variant, slightly saline	15	IVw-369P	67	-------	--	7
AyA	Aysees gravelly sandy loam, 0 to 2 percent slopes	16	IIIs-4	66	VIIs-4	67	5
AyB	Aysees gravelly sandy loam, 2 to 4 percent slopes	16	IIIe-4	64	VIIs-4	67	4
Ba	Bastian fine sandy loam, strongly saline	17	IIw-6	62	VIIw-6	67	8
Bc	Bastian silt loam, moderately saline	17	IIw-6	62	VIIw-6	67	8
Bd	Bastian silt loam, strongly saline	17	IIw-6	62	VIIw-6	67	8
Bs	Belted sandy loam	18	-------	--	VIIs-8	68	--
BuC	Bluewing very gravelly loamy sand, 2 to 12 percent slopes	18	-------	--	VIIs-L	68	--
CaC	Carrizo gravelly sand, 0 to 12 percent slopes	19	-------	--	VIIs-L	68	--
CbC	Carrizo stony loamy sand, 0 to 12 percent slopes	19	-------	--	VIIs-L	68	--
Cd	Clay dune land-Playa association	19					
	Clay dune land	--	-------	--	VIIIs-6	68	--
	Playa	--	-------	--	VIIIw-F	68	--
CfA	Cliffdown gravelly sandy loam, 0 to 2 percent slopes	20	IIIs-4	66	VIIs-4	67	5
CfB2	Cliffdown gravelly sandy loam, 2 to 4 percent slopes, eroded	20	IIIe-4	64	VIIs-4	67	6
ChA	Cliffdown loamy sand, 0 to 2 percent slopes	20	IIIs-L	66	VIIs-4	67	5
CkB	Cliffdown sandy loam, 2 to 4 percent slopes	20	IIIe-4	64	VIIs-4	67	5
ClB2	Cliffdown very gravelly sandy loam, 2 to 4 percent slopes, eroded	21	-------	--	VIIs-4	67	5
CmC	Crystal Springs cobbly fine sandy loam, 2 to 8 percent slopes	21	-------	--	VIIs-8	68	--
CnB	Crystal Springs gravelly loam, 2 to 4 percent slopes	21	-------	--	VIIs-8	68	--

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability units: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Wildlife site Number
CsB	Crystal Springs-Cliffdown association, 2 to 4 percent slopes	22					
	Crystal Springs gravelly loam, 2 to 4 percent slopes	--	-------	--	VIIs-8	68	--
	Cliffdown gravelly sandy loam, 2 to 4 percent slopes	--	-------	--	VIIs-4	67	--
FaA	Fang fine sandy loam, 0 to 2 percent slopes	22	I-1	61	VIIc-K	68	1
FaB	Fang fine sandy loam, 2 to 4 percent slopes	23	IIe-1	62	VIIc-K	68	1
FgA	Fang gravelly fine sandy loam, overflow, 0 to 2 percent slopes	23	IIw-F	63	VIIc-K	68	1
FhB	Fang gravelly sandy loam, 2 to 4 percent slopes	23	IIe-1	62	VIIc-K	68	1
FlA	Fang loamy fine sand, 0 to 2 percent slopes	23	IIs-L	64	VIIs-4	67	3
FmA	Fang loamy fine sand, overblown, 0 to 2 percent slopes	23	IIs-L	64	VIIs-4	67	3
FnA	Fang sandy loam, 0 to 2 percent slopes	24	I-1	61	VIIc-K	68	1
FpA	Fang sandy loam, slightly saline-alkali, 0 to 2 percent slopes	24	I-1	61	VIIs-6	68	1
FrB	Fang sandy loam, deep, 2 to 4 percent slopes	24	IIe-1	62	VIIs-4	67	1
FsB	Fang-Nyala association, 2 to 4 percent slopes	24					
	Fang fine sandy loam, 2 to 4 percent slopes	--	IIe-1	62	VIIc-K	68	1
	Nyala sandy loam, 2 to 4 percent slopes	--	IIe-1	62	VIIs-4	67	1
Ge	Geer fine sandy loam	25	I-1	61	VIIc-K	68	2
Gf	Geer fine sandy loam, slightly saline	25	I-1	61	VIIs-6	68	2
Gh	Geer fine sandy loam, water table, strongly saline	25	IIw-2	62	VIIw-6	67	2
Gk	Geer silt loam	25	I-1	61	VIIc-K	68	2
Gl	Geer silt loam, water table	26	IIw-2	62	-------	--	2
Gm	Geer silt loam, water table, moderately saline	26	IIw-2	62	VIIw-6	67	2
Gn	Geer silt loam, water table, slightly saline	26	IIw-2	62	VIIw-6	67	2
Ja	Jarboe sandy loam, saline-alkali	27	-------	--	VIIs-6	68	--
Jb	Jarboe very fine sandy loam, strongly saline-alkali	27	-------	--	VIIs-6	68	--
Kp	Kawich-Playa complex	27					
	Kawich fine sand, 0 to 12 percent slopes	--	-------	--	VIIs-L	68	--
	Playa	--	-------	--	VIIIw-F	68	--
KsB	Koyen sandy loam, 2 to 4 percent slopes	28	IIe-1	62	VIIs-4	67	1
KtB	Koyen-Tickapoo association, 2 to 4 percent slopes	28					
	Koyen sandy loam, 2 to 4 percent slopes	--	IIe-1	62	VIIs-4	67	11
	Tickapoo sandy loam, 2 to 4 percent slopes	--	IIIe-3	64	VIIs-4	67	--
LaA	Lahontan fine sandy loam, water table variant, 0 to 2 percent slopes	29	IIw-69	62	-------	--	7
LaB	Lahontan fine sandy loam, water table variant, 2 to 4 percent slopes	29	IIIw-136	65	-------	--	4
LhA	Lahontan silt loam, water table variant, 0 to 2 percent slopes	29	IVw-369P	67	-------	--	7
LhB	Lahontan silt loam, water table variant, 2 to 4 percent slopes	30	IIIw-136	65	-------	--	4
LmA	Lahontan silt loam, water table variant, moderately saline, 0 to 2 percent slopes	30	VIw-6	67	-------	--	9
Ln	Lahontan silty clay, poorly drained variant	30	VIw-6	67	-------	--	10
LrC	Leo extremely rocky sandy loam, 2 to 12 percent slopes	31	-------	--	VIIs-7	68	--
LsC	Leo gravelly sandy loam, 2 to 12 percent slopes	31	-------	--	VIIs-4	67	--

Map symbol	Mapping unit	Described on page	Capability units: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Wildlife site Number
MkC	Maynard Lake gravelly soils, 4 to 12 percent slopes	32	-------	--	VIIs-L	68	--
MlB	Maynard Lake loamy sand, 0 to 4 percent slopes	32	IIIs-L	66	VIIs-L	68	5
MlC	Maynard Lake loamy sand, 4 to 12 percent slopes	32	-------	--	VIIs-L	68	--
Mn	McCutchen loam	33	-------	--	VIIs-6	68	--
Mr	Monte Cristo fine sandy loam	34	-------	--	VIIs-8	68	--
NeD	Nevoyer gravelly loam, 4 to 12 percent slopes	34	-------	--	VIIs-8	68	--
Pa	Pahranagat silt loam	36	IIIw-9P	65	-------	--	7
Pb	Pahranagat silt loam, drained	36	IIw-9	63	-------	--	6
Pc	Pahranagat silt loam, drained, slightly saline	36	IIw-69	62	-------	--	7
Pd	Pahranagat silt loam, slightly saline	36	IIIw-69P	65	-------	--	7
Pe	Pahranagat-Ash Springs complex	36					
	Pahranagat silt loam, slightly saline	--	IIIw-69P	65	-------	--	7
	Ash Springs silt loam	--	IIIw-69P	65	-------	--	7
Pg	Pahranagat-Ash Springs complex, seeped	37					
	Pahranagat silt loam, seeped, slightly saline	--	Vw-2	67	-------	--	10
	Ash Springs silt loam, seeped, slightly saline	--	Vw-2	67	-------	--	10
Ph	Pahranagat-Ash Springs variant complex	37					
	Pahranagat silt loam, slightly saline	--	IIIw-69P	65	-------	--	7
	Ash Springs silty clay loam, heavy subsoil variant, slightly saline	--	IVw-369P	67	-------	--	7
Pk	Pahranagat-Ash Springs variant complex, drained	37					
	Pahranagat silt loam, drained, slightly saline	--	IIw-69	62	-------	--	7
	Ash Springs silt loam, heavy subsoil variant, somewhat poorly drained, slightly saline	--	IIIw-69P	65	-------	--	7
PlC	Pahroc gravelly loam, 2 to 8 percent slopes	38	-------	--	VIIs-8	68	--
PmA	Papoose loamy fine sand, 0 to 2 percent slopes	38	IIIs-L	66	VIIs-4	67	5
PnA	Papoose sandy loam, 0 to 2 percent slopes	39	IIIs-4	66	VIIs-4	67	5
PnA2	Papoose sandy loam, 0 to 2 percent slopes, eroded	39	IIIs-4	66	VIIs-4	67	5
PnB	Papoose sandy loam, 2 to 4 percent slopes	39	IIIe-4	64	VIIs-4	67	5
PoA	Papoose sandy loam, slightly saline, 0 to 2 percent slopes	39	IIs-4	63	VIIs-4	67	3
Pp	Peat	39	Vw-2	67	-------	--	11
Pr	Penoyer loam, moderately saline-alkali	40	I-1	61	VIIs-6	68	2
Ps	Penoyer loam, slightly saline-alkali	40	I-1	61	VIIs-6	68	2
Pt	Penoyer silt loam	40	I-1	61	VIIc-K	68	1
Pu	Penoyer silt loam, slightly saline-alkali	41	IIw-F	63	VIIs-6	68	2
PvE	Pintwater rocky sandy loam, 12 to 45 percent slopes	41	-------	--	VIIs-7	68	--
Pw	Puddle fine sandy loam	42	IIs-6	64	VIIs-6	68	3
Rl	Rock land	42	-------	--	VIIIs-7	69	--
SaA	Seaman fine sandy loam, hummocky, 0 to 2 percent slopes	43	IIs-4	63	VIIs-4	67	3
SbA	Seaman loamy fine sand, 0 to 2 percent slopes	43	IIs-L	64	VIIs-4	67	3
ScA	Seaman sandy loam, 0 to 2 percent slopes	43	IIs-4	63	VIIs-4	67	3
ScB	Seaman sandy loam, 2 to 4 percent slopes	43	IIe-1	62	VIIs-4	67	3
SdA	Seaman sandy loam, water table, slightly saline, 0 to 2 percent slopes	44	IIw-2	62	VIIw-6	67	4
SeA	Seaman sandy loam, water table, strongly saline, 0 to 2 percent slopes	44	IIw-2	62	VIIw-6	67	4

Map symbol	Mapping unit	Described on page	Capability units: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Wildlife site Number
SfC	Sierocliff extremely stony very fine sandy loam, 4 to 12 percent slopes	45	-------	--	VIIs-7	68	--
SgC	Silent gravelly loam, 2 to 12 percent slopes	45	-------	--	VIIs-8	68	--
ShB	Silent gravelly sandy loam, 2 to 4 percent slopes	45	-------	--	VIIs-8	68	--
SkD	Silent very rocky loam, 4 to 12 percent slopes	46	-------	--	VIIs-7	68	--
SlD	Silverbow extremely stony very fine sandy loam, 8 to 12 percent slopes	46	-------	--	VIIs-7	68	--
Sm	Slickens	46	-------	--	VIIIs-6	68	--
SnC2	Specter gravelly loam, 2 to 12 percent slopes, eroded	47	-------	--	VIIs-8	68	--
St	Stumble loamy sand	48	IIIs-L	66	VIIs-L	68	5
Su	Stumble loamy sand, deep	48	IIIs-L	66	VIIs-L	68	5
SvA2	Sundown loamy sand, 0 to 2 percent slopes, eroded	48	IIIs-L	66	VIIs-L	68	5
SwA	Sundown sandy loam, 0 to 2 percent slopes	49	IIIs-4	66	VIIs-4	67	5
SyB2	Sundown very gravelly loamy sand, 2 to 4 percent slopes, eroded	49	-------	--	VIIs-L	68	--
TaF	Theriot extremely rocky loam, 30 to 100 percent slopes	49	-------	--	VIIs-7	68	--
TcA	Tickapoo gravelly fine sandy loam, 0 to 2 percent slopes	50	IIIs-3	66	VIIs-4	67	3
TdB	Tickapoo gravelly sandy loam, 2 to 4 percent slopes	50	IIIe-3	64	VIIs-4	67	3
TdB2	Tickapoo gravelly sandy loam, 2 to 4 percent slopes, eroded	51	IIIe-3	64	VIIs-4	67	3
TkB	Tickapoo sandy loam, 2 to 4 percent slopes	51	IIIe-3	64	VIIs-4	67	3
TlC	Tickapoo-Leo association, 4 to 12 percent slopes	51					
	Tickapoo gravelly sandy loam, 4 to 12 percent slopes	--	-------	--	VIIs-4	67	--
	Leo gravelly sandy loam, 4 to 12 percent slopes	--	-------	--	VIIs-4	67	--
TmC	Timpahute very stony clay loam, 2 to 12 percent slopes	52	-------	--	VIIs-7	68	--
TnC	Timpahute-Leo association, 2 to 12 percent slopes	52					
	Timpahute very stony clay loam, 2 to 12 percent slopes	--	-------	--	VIIs-7	68	--
	Leo gravelly sandy loam, 2 to 12 percent slopes	--	-------	--	VIIs-4	67	--
Tp	Timper sandy loam	53	-------	--	VIIs-8	68	--
Tr	Tippipah sandy loam	54	IIIs-3	66	VIIs-4	67	3
TsD	Tolicha extremely stony very fine sandy loam, 4 to 12 percent slopes	54	-------	--	VIIs-7	68	3
TuD	Tufa rock land-Kawich association, 0 to 12 percent slopes	55					
	Tufa rock land	--	-------	--	VIIIs-7	69	--
	Kawich fine sand, 0 to 12 percent slopes	--	-------	--	VIIs-L	68	--
Wc	Woodrow clay loam	55	IIs-6	64	VIIs-6	68	4

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CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Oil wells

Windmill

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Area boundary and limit of detailed soil survey

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches (CANAL, DITCH)

Lakes and ponds
- Perennial
- Intermittent

Wells (flowing)

Springs

Marsh

Wet spot

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies

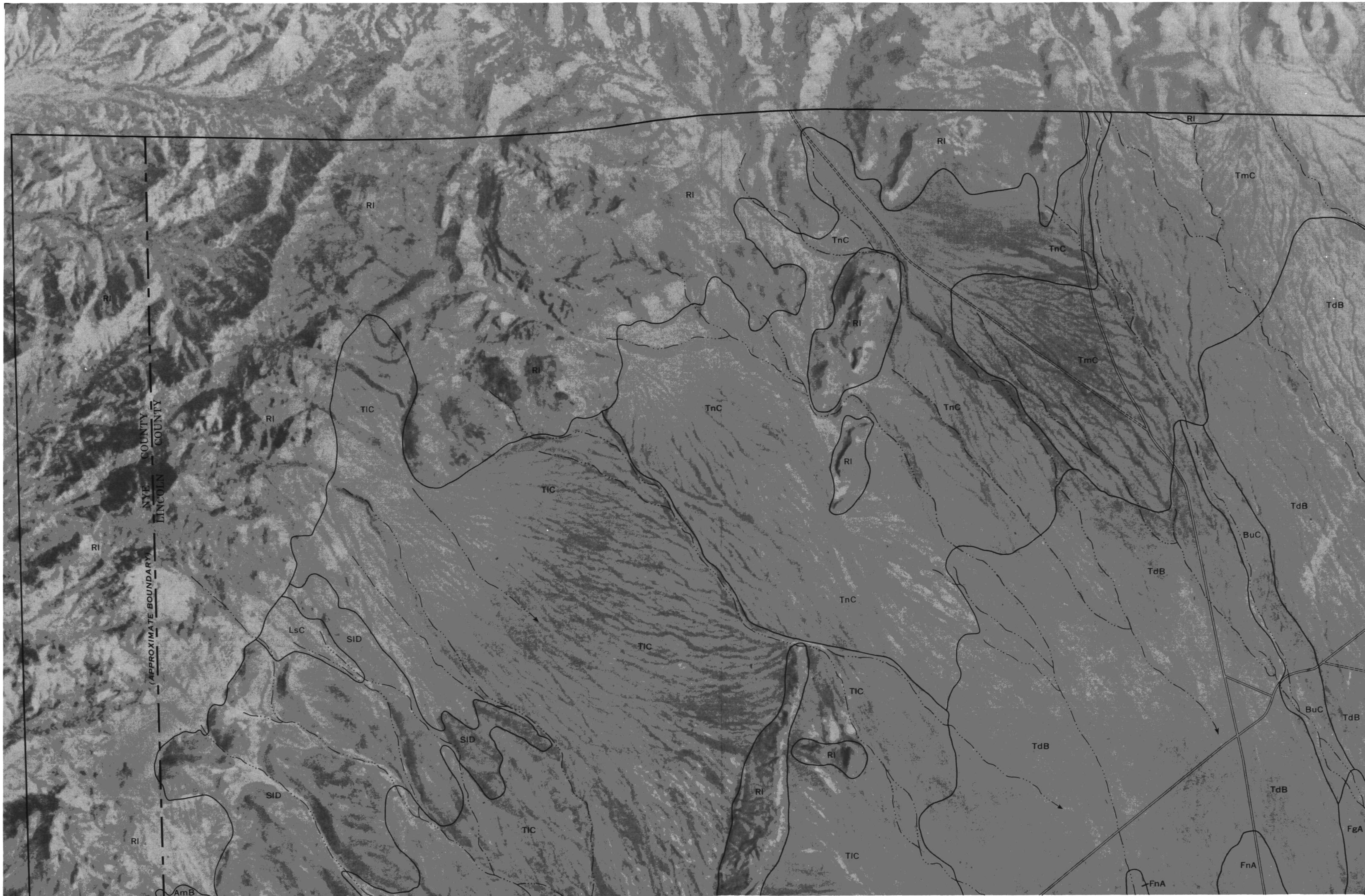
SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F shows the slope. Symbols without a slope letter are those of nearly level soils or land types. A final number, 2, in the symbol shows that the soil is eroded.

SYMBOL	NAME
Ad	Adaven loam
AkB	Alko loamy coarse sand, 0 to 8 percent slopes
AlB	Alko stony loamy coarse sand, 0 to 8 percent slopes
AmB	Alko–Tickapoo–Rock land association, 2 to 8 percent slopes
An	Ash Springs fine sandy loam, somewhat poorly drained
Ao	Ash Springs silt loam
Ap	Ash Springs silt loam, somewhat poorly drained
Ar	Ash Springs silt loam, reclaimed
As	Ash Springs silty clay loam
At	Ash Springs silt loam, heavy subsoil variant, somewhat poorly drained
Au	Ash Springs silt loam, heavy subsoil variant, slightly saline
Av	Ash Springs silty clay loam, heavy subsoil variant, slightly saline
AyA	Aysees gravelly sandy loam, 0 to 2 percent slopes
AyB	Aysees gravelly sandy loam, 2 to 4 percent slopes
Ba	Bastian fine sandy loam, strongly saline
Bc	Bastian silt loam, moderately saline
Bd	Bastian silt loam, strongly saline
Bs	Belted sandy loam
BuC	Bluewing very gravelly loamy sand, 2 to 12 percent slopes
CaC	Carrizo gravelly sand, 0 to 12 percent slopes
CbC	Carrizo stony loamy sand, 0 to 12 percent slopes
Cd	Clay dune land–Playa association
CfA	Cliffdown gravelly sandy loam, 0 to 2 percent slopes
CfB2	Cliffdown gravelly sandy loam, 2 to 4 percent slopes, eroded
ChA	Cliffdown loamy sand, 0 to 2 percent slopes
CkB	Cliffdown sandy loam, 2 to 4 percent slopes
ClB2	Cliffdown very gravelly sandy loam, 2 to 4 percent slopes, eroded
CmC	Crystal Springs cobbly fine sandy loam, 2 to 8 percent slopes
CnB	Crystal Springs gravelly loam, 2 to 4 percent slopes
CsB	Crystal Springs–Cliffdown association, 2 to 4 percent slopes
FaA	Fang fine sandy loam, 0 to 2 percent slopes
FaB	Fang fine sandy loam, 2 to 4 percent slopes
FgA	Fang gravelly fine sandy loam, overflow, 0 to 2 percent slopes
FhB	Fang gravelly sandy loam, 2 to 4 percent slopes
FlA	Fang loamy fine sand, 0 to 2 percent slopes
FmA	Fang loamy fine sand, overblown, 0 to 2 percent slopes
FnA	Fang sandy loam, 0 to 2 percent slopes
FpA	Fang sandy loam, slightly saline–alkali, 0 to 2 percent slopes
FrB	Fang sandy loam, deep, 2 to 4 percent slopes
FsB	Fang–Nyala association, 2 to 4 percent slopes
Ge	Geer fine sandy loam
Gf	Geer fine sandy loam, slightly saline
Gh	Geer fine sandy loam, water table, strongly saline
Gk	Geer silt loam
Gl	Geer silt loam, water table
Gm	Geer silt loam, water table, moderately saline
Gn	Geer silt loam, water table, slightly saline
Ja	Jarboe sandy loam, saline–alkali
Jb	Jarboe very fine sandy loam, strongly saline–alkali
Kp	Kawich–Playa complex
KsB	Koyen sandy loam, 2 to 4 percent slopes
KtB	Koyen–Tickapoo association, 2 to 4 percent slopes
LaA	Lahontan fine sandy loam, water table variant, 0 to 2 percent slopes
LaB	Lahontan fine sandy loam, water table variant, 2 to 4 percent slopes
LhA	Lahontan silt loam, water table variant, 0 to 2 percent slopes
LhB	Lahontan silt loam, water table variant, 2 to 4 percent slopes
LmA	Lahontan silt loam, water table variant, moderately saline, 0 to 2 percent slopes
Ln	Lahontan silty clay, poorly drained variant
LrC	Leo extremely rocky sandy loam, 2 to 12 percent slopes
LsC	Leo gravelly sandy loam, 2 to 12 percent slopes

SYMBOL	NAME
MkC	Maynard Lake gravelly soils, 4 to 12 percent slopes
MlB	Maynard Lake loamy sand, 0 to 4 percent slopes
MlC	Maynard Lake loamy sand, 4 to 12 percent slopes
Mn	McCutchen loam
Mr	Monte Cristo fine sandy loam
NeD	Nevoyer gravelly loam, 4 to 12 percent slopes
Pa	Pahranagat silt loam
Pb	Pahranagat silt loam, drained
Pc	Pahranagat silt loam, drained, slightly saline
Pd	Pahranagat silt loam, slightly saline
Pe	Pahranagat–Ash Springs complex
Pg	Pahranagat–Ash Springs complex, seeped
Ph	Pahranagat–Ash Springs variant complex
Pk	Pahranagat–Ash Springs variant complex, drained
PlC	Pahroc gravelly loam, 2 to 8 percent slopes
PmA	Papoose loamy fine sand, 0 to 2 percent slopes
PnA	Papoose sandy loam, 0 to 2 percent slopes
PnA2	Papoose sandy loam, 0 to 2 percent slopes, eroded
PnB	Papoose sandy loam, 2 to 4 percent slopes
PoA	Papoose sandy loam, slightly saline, 0 to 2 percent slopes
Pp	Peat
Pr	Penoyer loam, moderately saline–alkali
Ps	Penoyer loam, slightly saline–alkali
Pt	Penoyer silt loam
Pu	Penoyer silt loam, slightly saline–alkali
PvE	Pintwater rocky sandy loam, 12 to 45 percent slopes
Pw	Puddle fine sandy loam
Rl	Rock land
SaA	Seaman fine sandy loam, hummocky, 0 to 2 percent slopes
SbA	Seaman loamy fine sand, 0 to 2 percent slopes
ScA	Seaman sandy loam, 0 to 2 percent slopes
ScB	Seaman sandy loam, 2 to 4 percent slopes
SdA	Seaman sandy loam, water table, slightly saline, 0 to 2 percent slopes
SeA	Seaman sandy loam, water table, strongly saline, 0 to 2 percent slopes
SfC	Sierocliff extremely stony very fine sandy loam, 4 to 12 percent slopes
SgC	Silent gravelly loam, 2 to 12 percent slopes
ShB	Silent gravelly sandy loam, 2 to 4 percent slopes
SkD	Silent very rocky loam, 4 to 12 percent slopes
SlD	Silverbow extremely stony very fine sandy loam, 8 to 12 percent slopes
Sm	Slickens
SnC2	Specter gravelly loam, 2 to 12 percent slopes, eroded
St	Stumble loamy sand
Su	Stumble loamy sand, deep
SvA2	Sundown loamy sand, 0 to 2 percent slopes, eroded
SwA	Sundown sandy loam, 0 to 2 percent slopes
SyB2	Sundown very gravelly loamy sand, 2 to 4 percent slopes, eroded
TaF	Theriot extremely rocky loam, 30 to 100 percent slopes
TcA	Tickapoo gravelly fine sandy loam, 0 to 2 percent slopes
TdB	Tickapoo gravelly sandy loam, 2 to 4 percent slopes
TdB2	Tickapoo gravelly sandy loam, 2 to 4 percent slopes, eroded
TkB	Tickapoo sandy loam, 2 to 4 percent slopes
TlC	Tickapoo–Leo association, 4 to 12 percent slopes
TmC	Timpahute very stony clay loam, 2 to 12 percent slopes
TnC	Timpahute–Leo association, 2 to 12 percent slopes
Tp	Timper sandy loam
Tr	Tippipah sandy loam
TsD	Tolicha extremely stony very fine sandy loam, 4 to 12 percent slopes
TuD	Tufa rock land–Kawich association, 0 to 12 percent slopes
Wc	Woodrow clay loam

Soil map constructed 1966 by Cartographic Division, Soil Conservation Service, USDA, from 1954 aerial photographs. Controlled mosaic based on Nevada plane coordinate system, east zone, transverse Mercator projection, 1927 North American datum.



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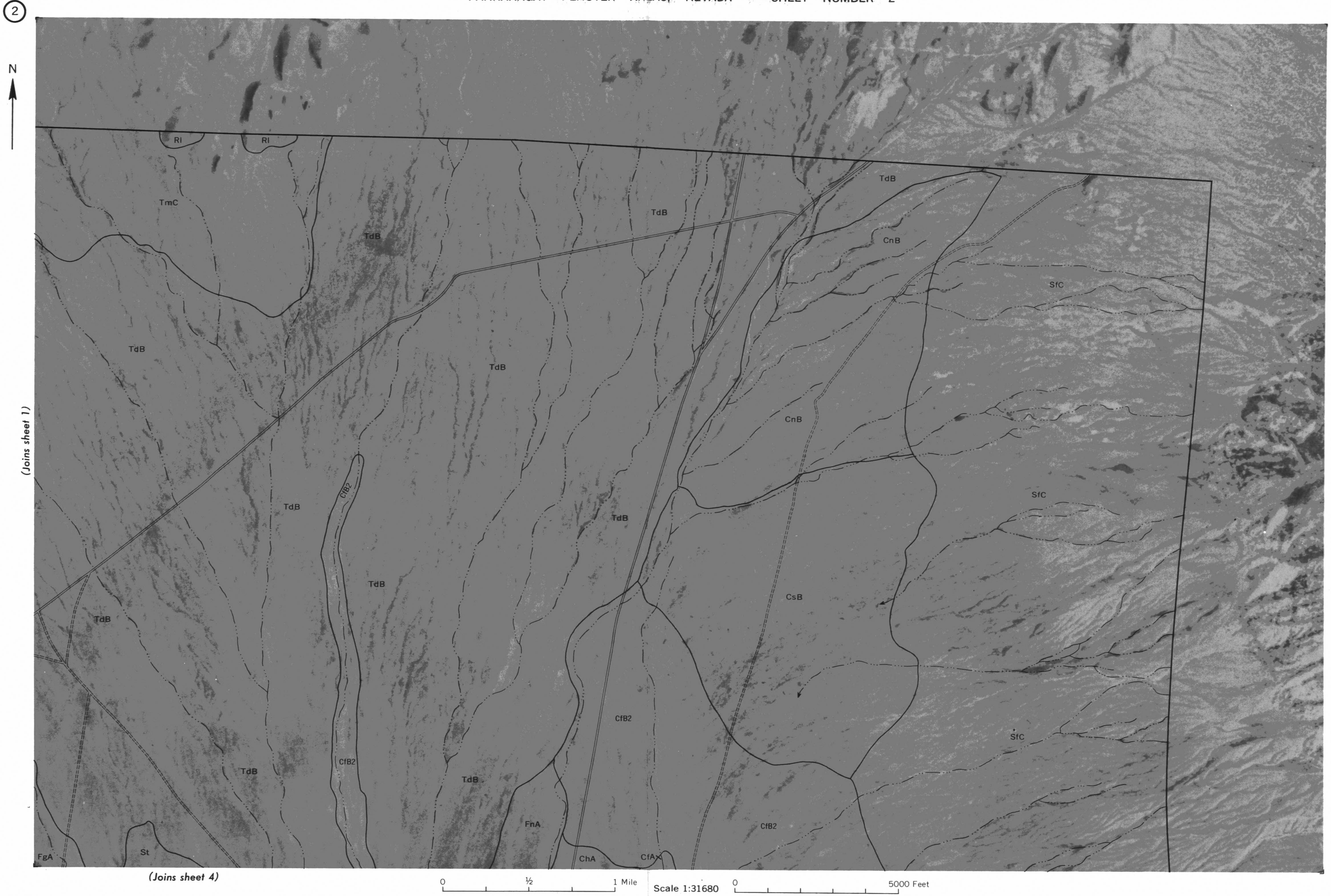
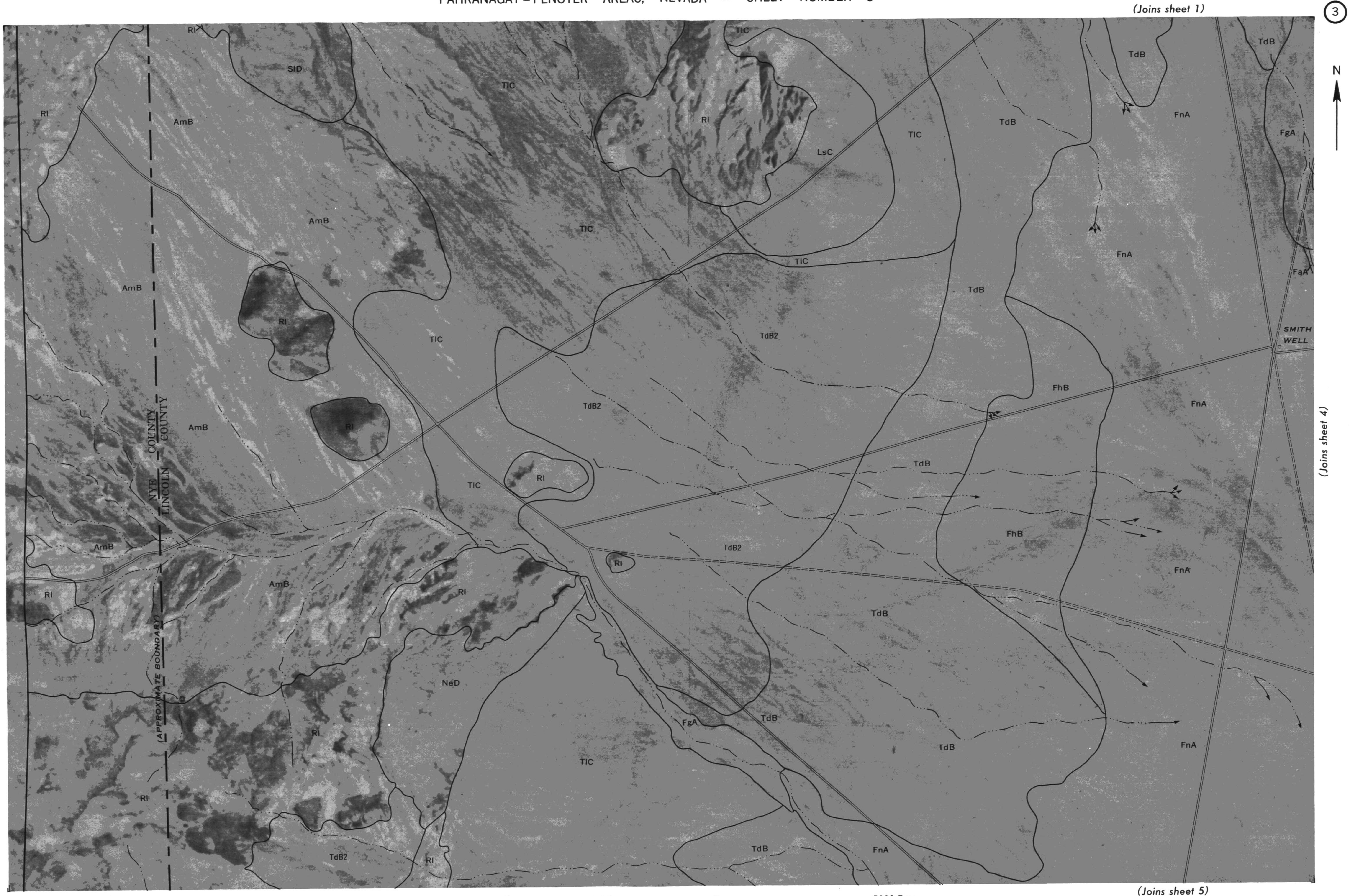
PAHRANAGAT – PENOYER AREAS, NEVADA — SHEET NUMBER 2





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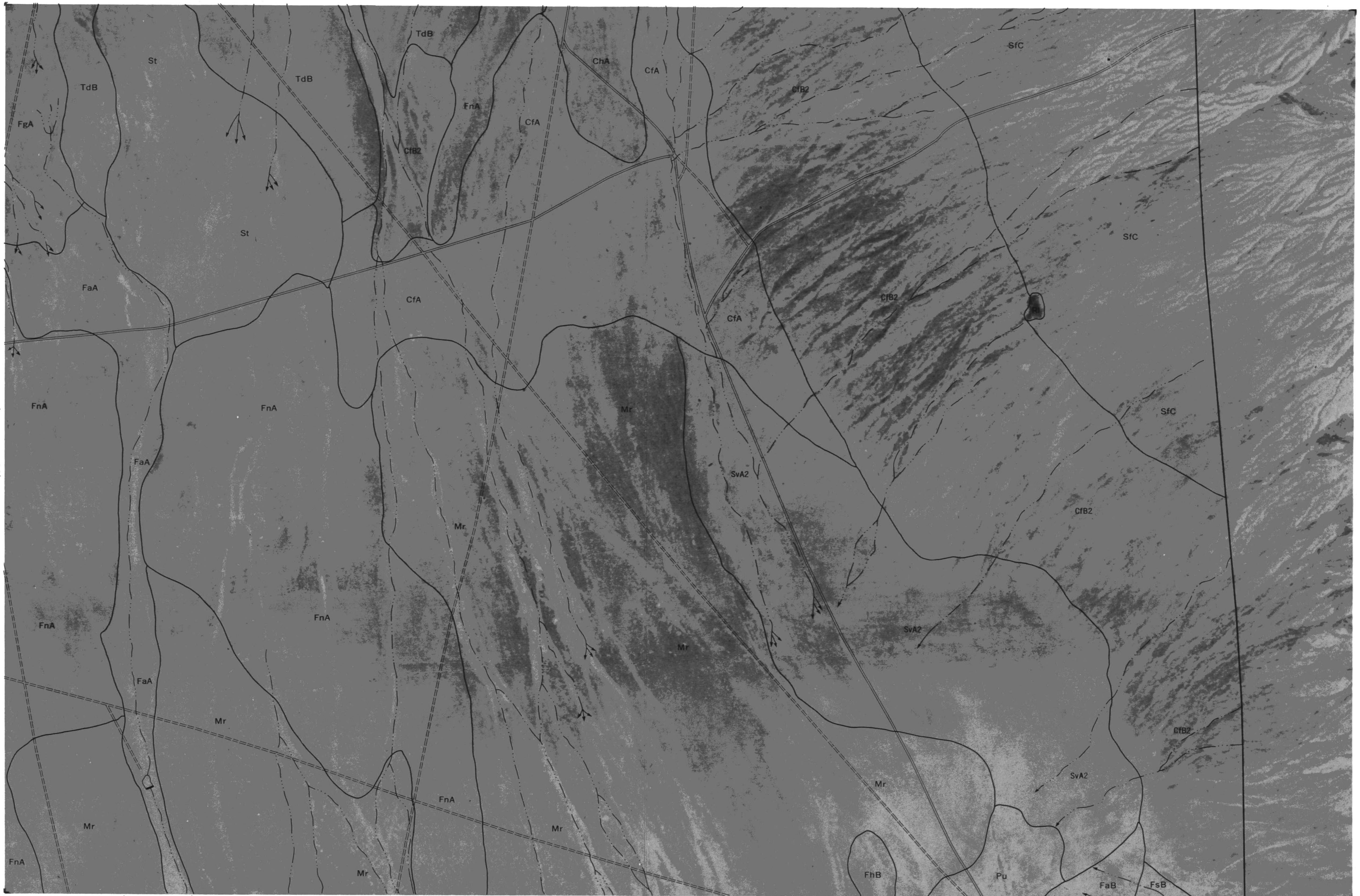
4

(Joins sheet 2)

N

(Joins sheet 3)



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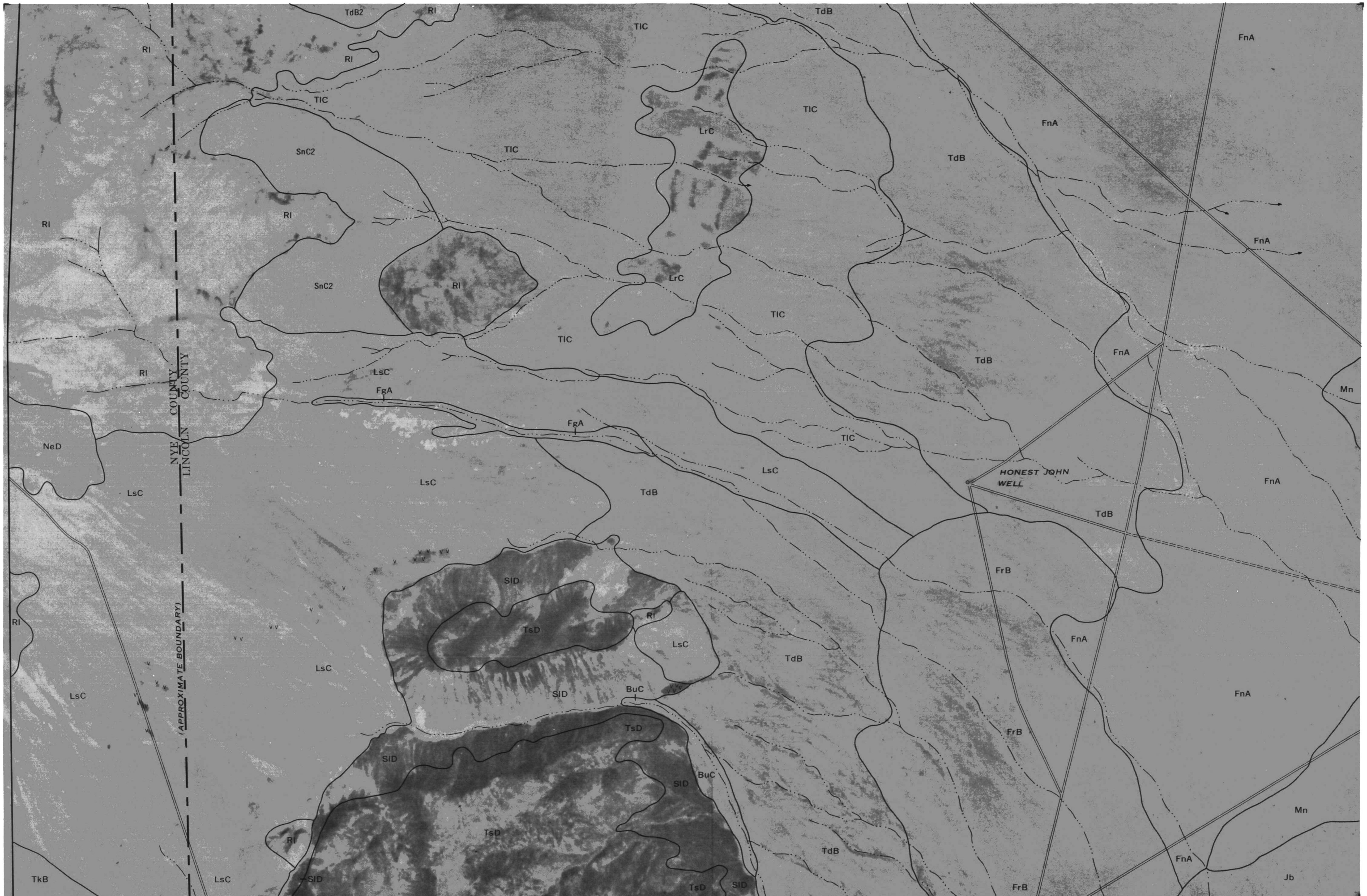
PAHRANAGAT - PENOYER AREAS, NEVADA NO. 4

(Joins sheet 3)



(Joins sheet 7)

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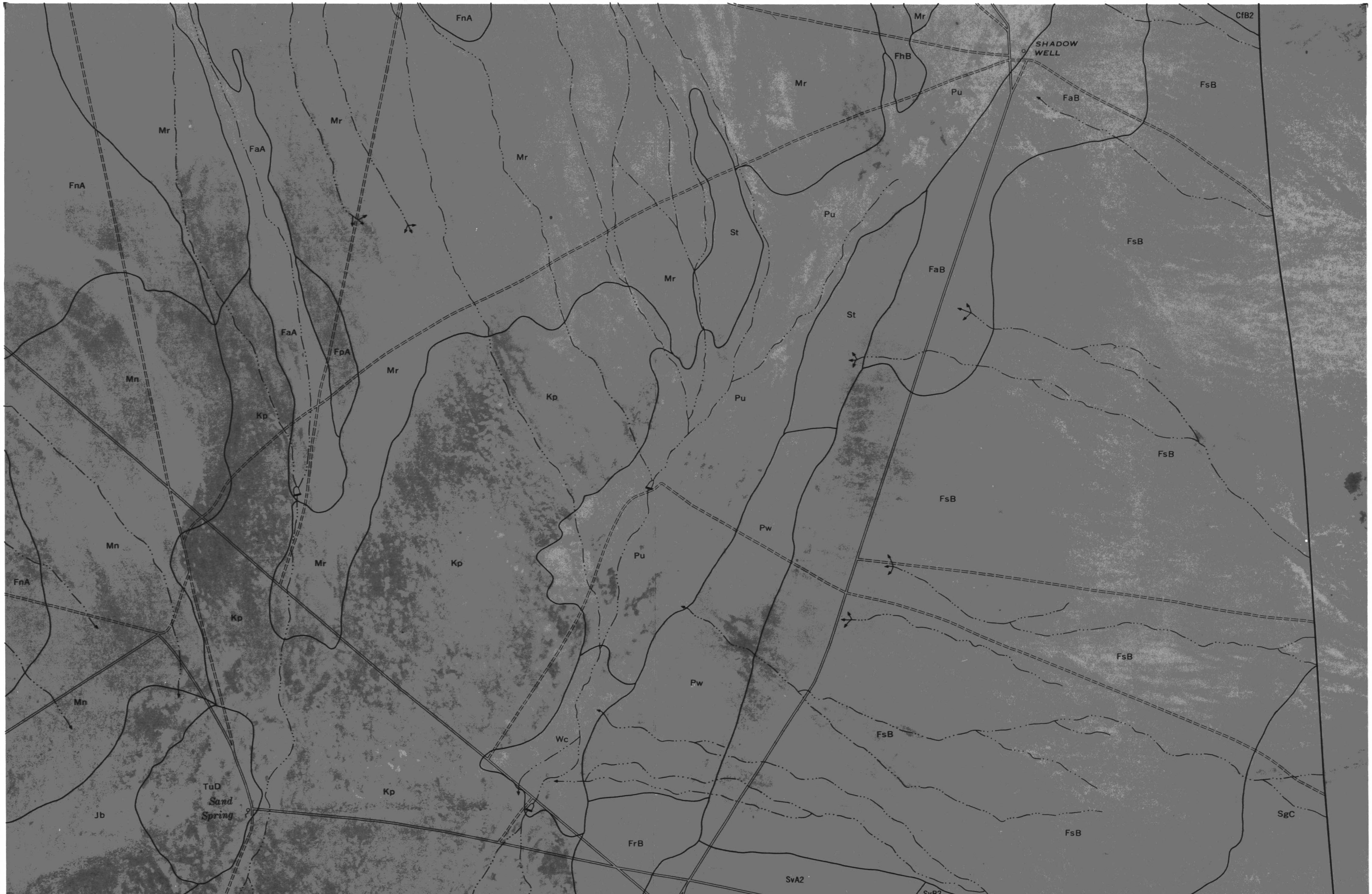
6

(Joins sheet 4)

N

(Joins sheet 5)



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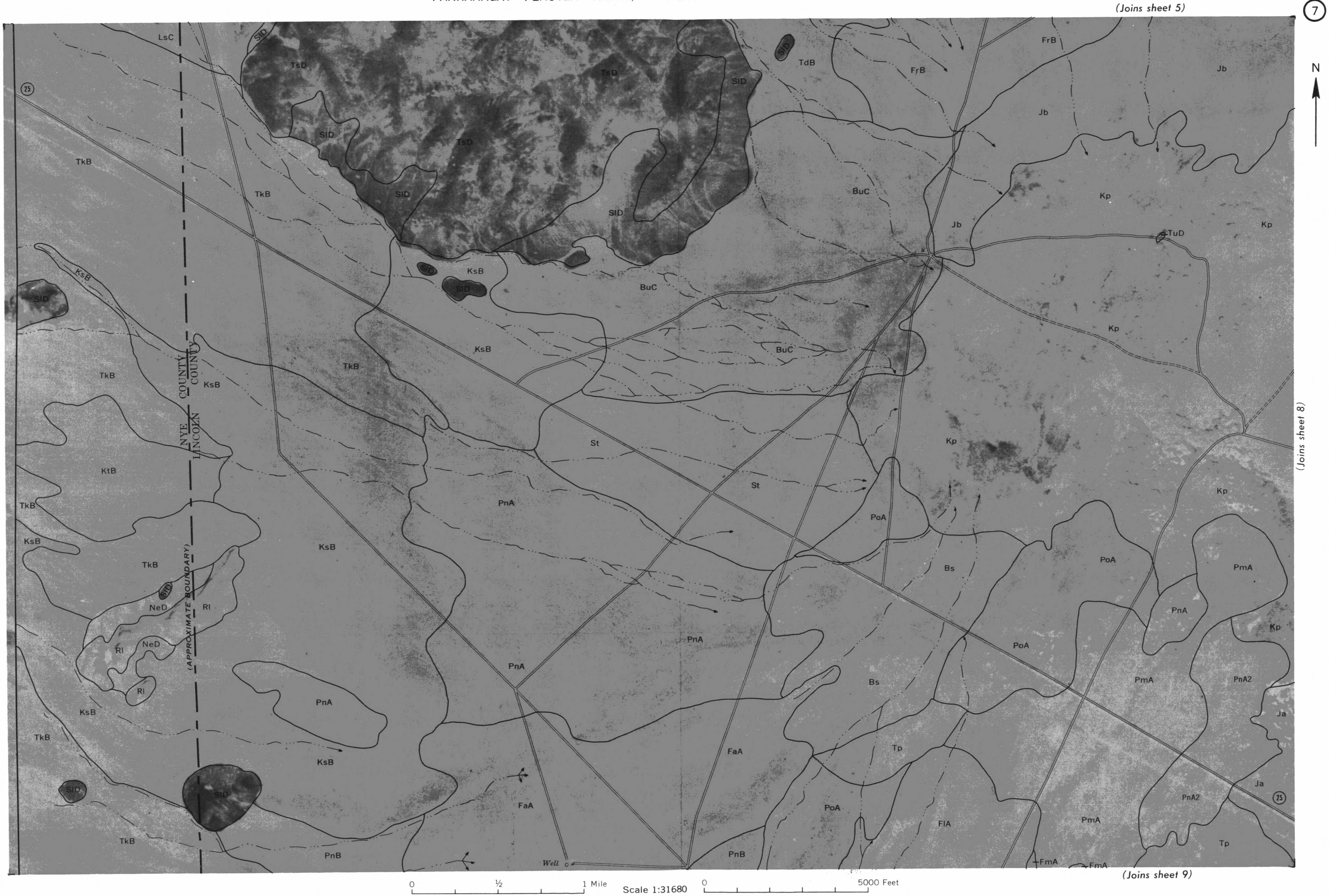
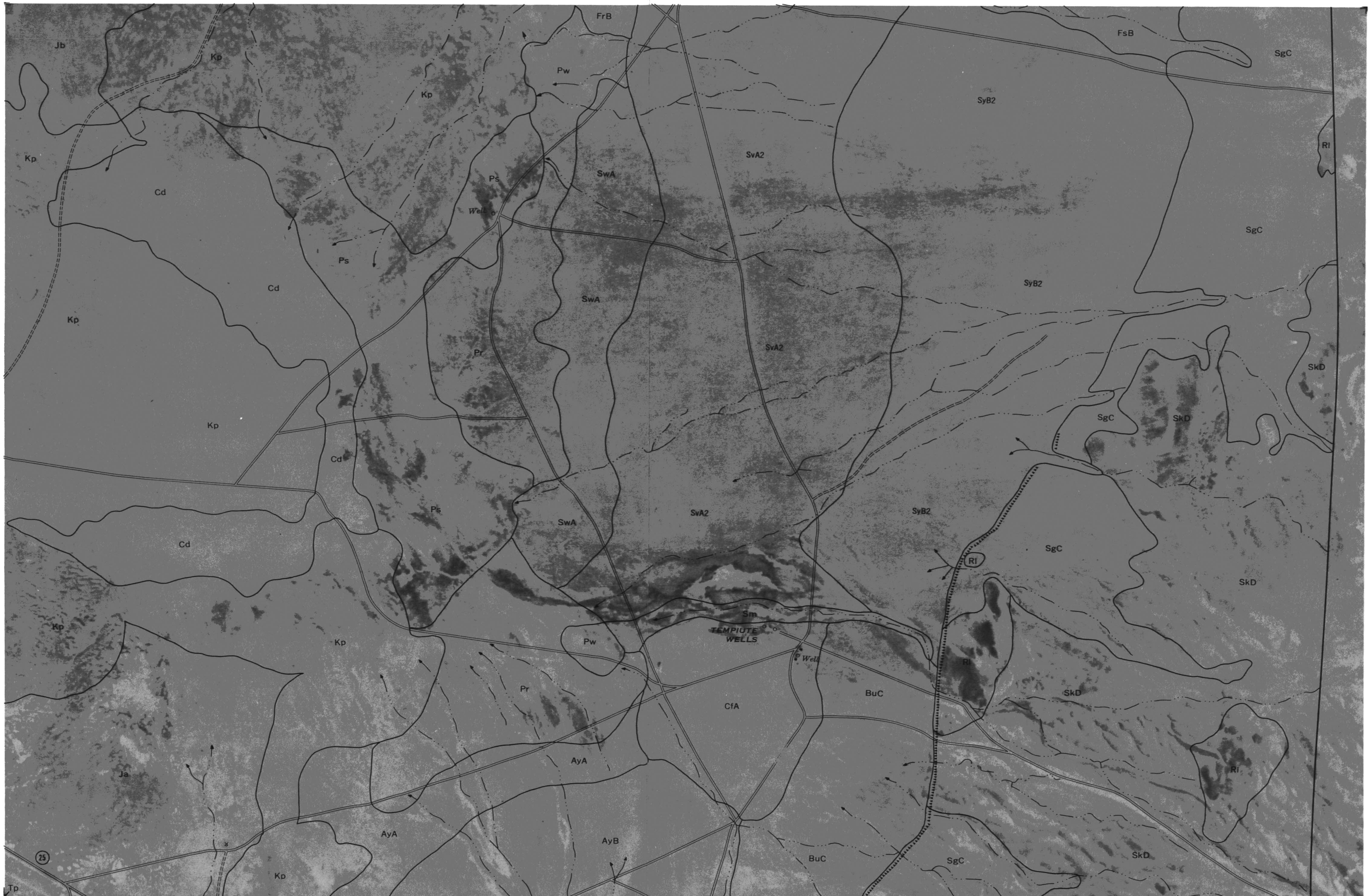
7


(Joins sheet 5)
(Joins sheet 8)
(Joins sheet 9)
N
NYE COUNTY
LINCOLN COUNTY
(APPROXIMATE BOUNDARY)
25
LsC
TsD
SlD
TdB
FrB
Jb
TkB
BuC
Kp
TuD
KsB
KtB
St
PnA
PoA
Bs
PmA
NeD
Rl
FaA
Tp
PnA2
Ja
PnB
FlA
FmA
Well
0
½
1 Mile
Scale 1:31680
0
5000 Feet

8

(Joins sheet 6)

(Joins sheet 7)



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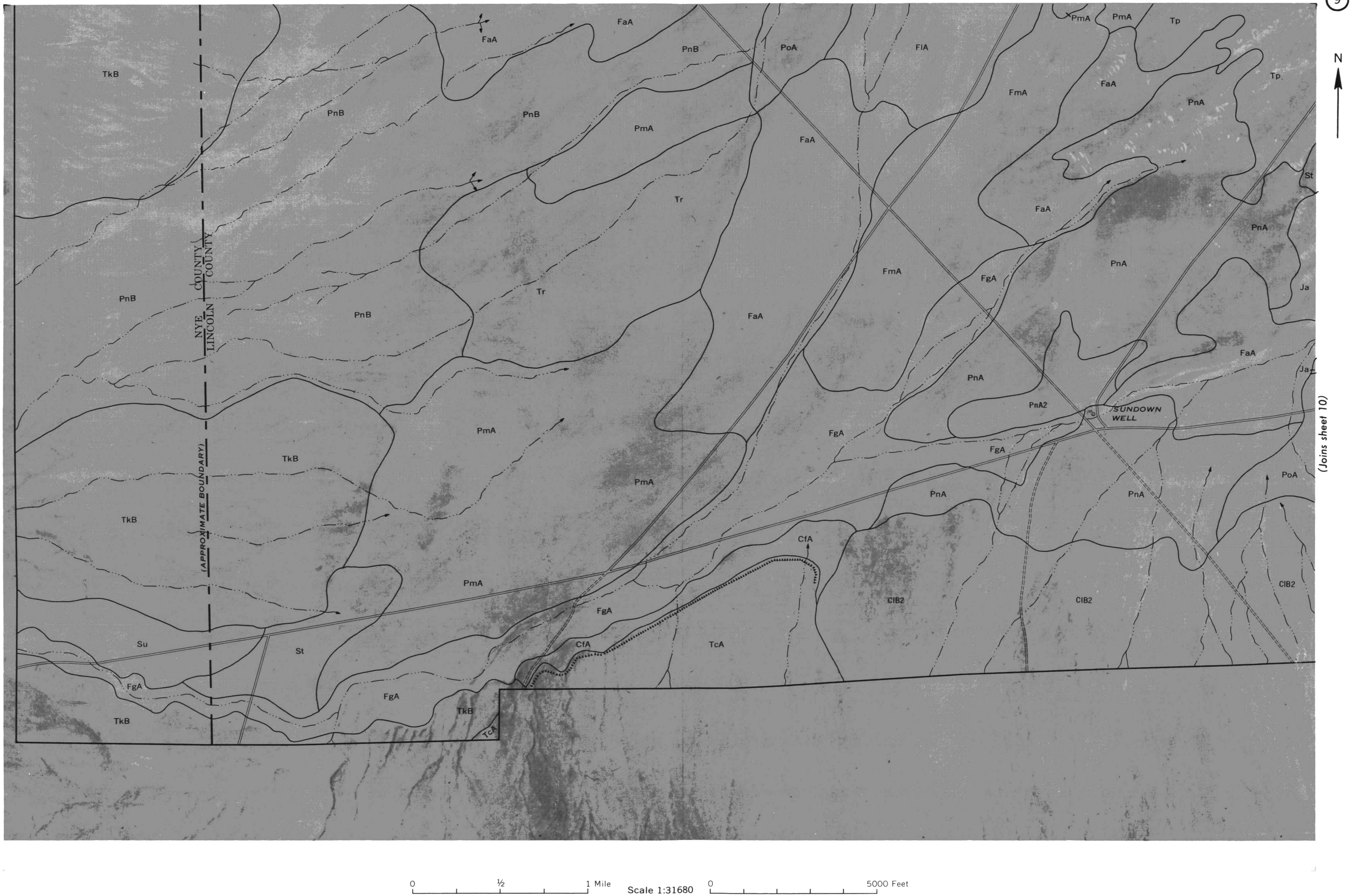
(Joins sheet 7)

9

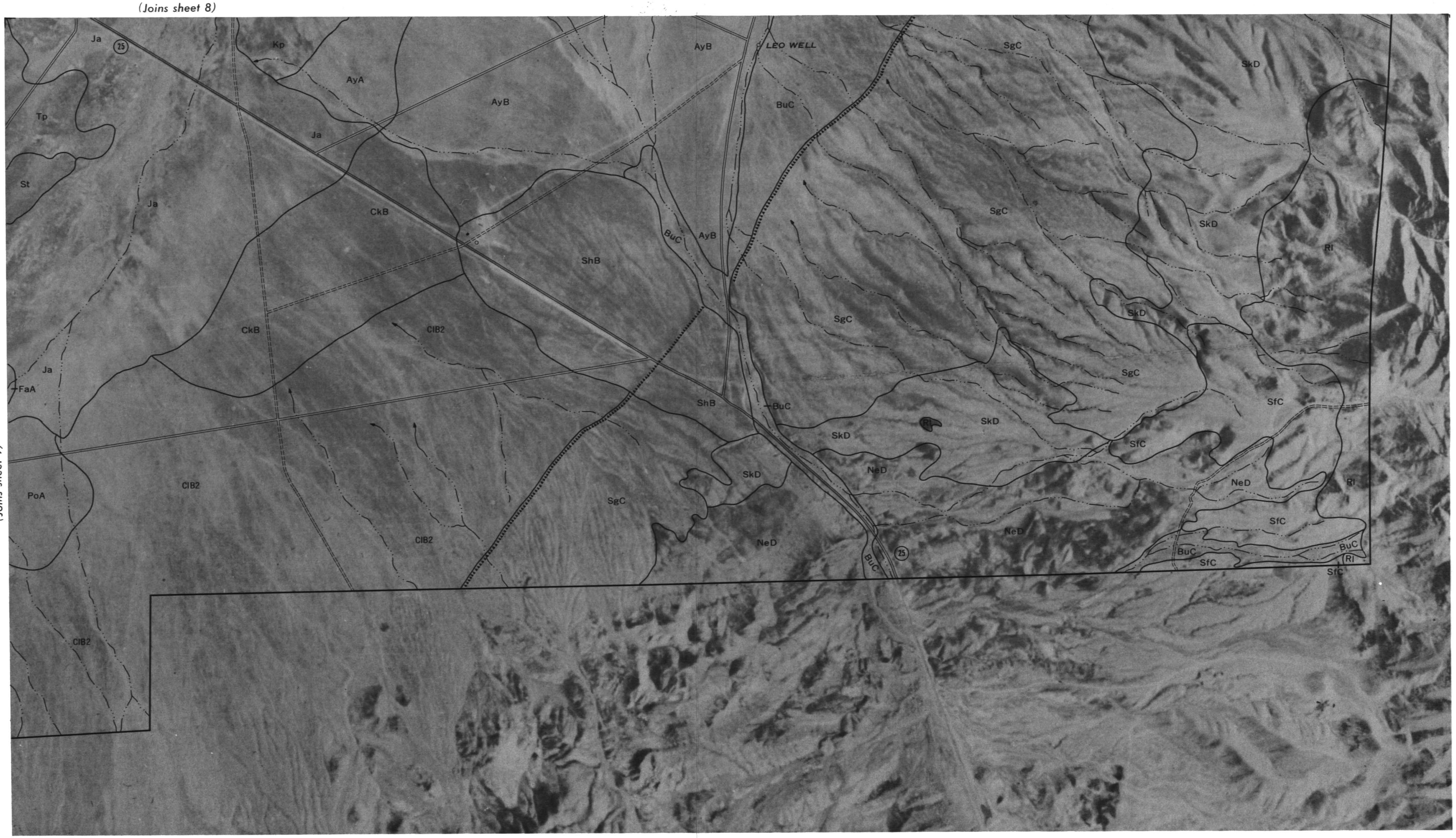


10

(Joins sheet 8)

N

(Joins sheet 9)



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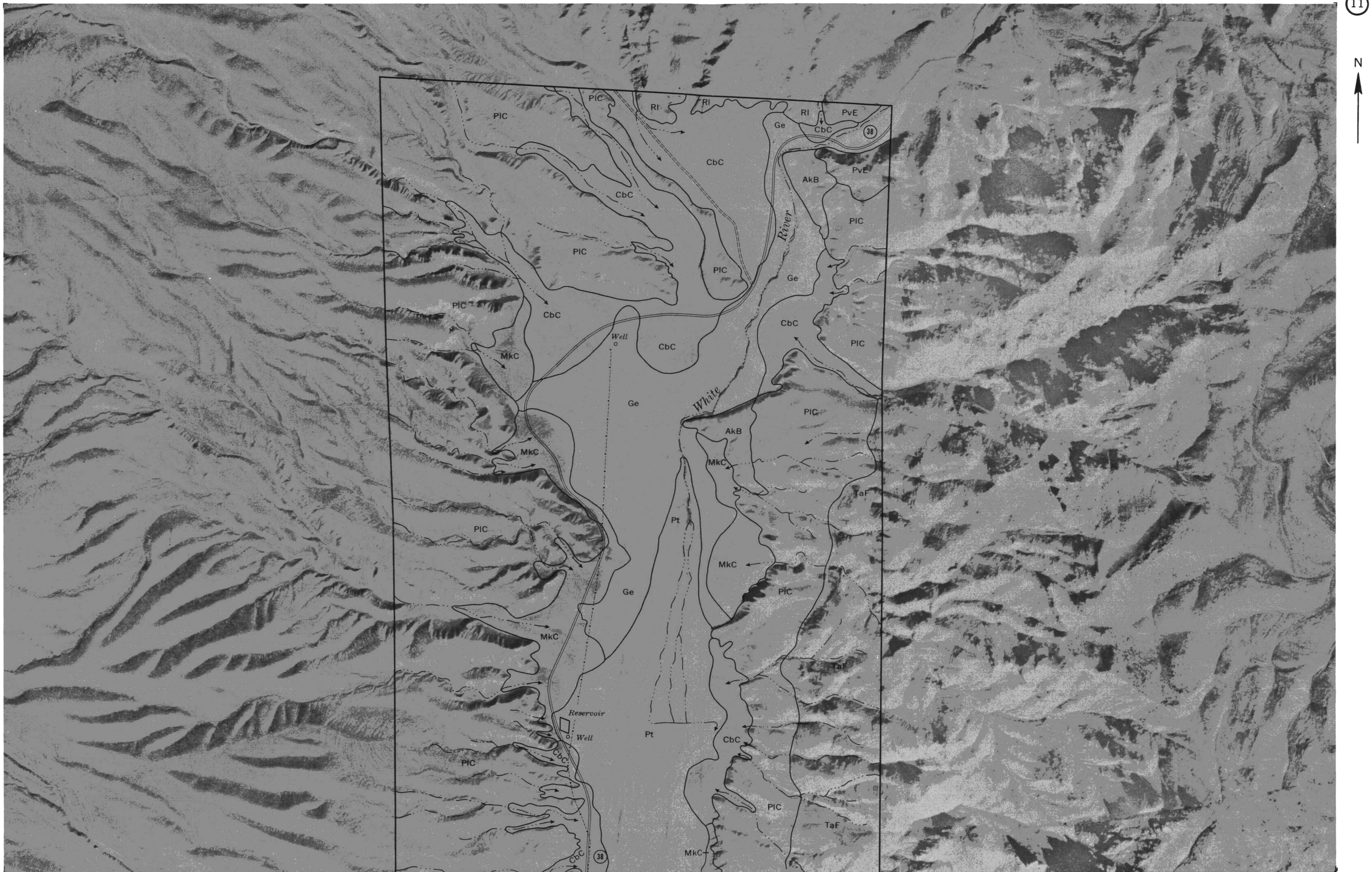

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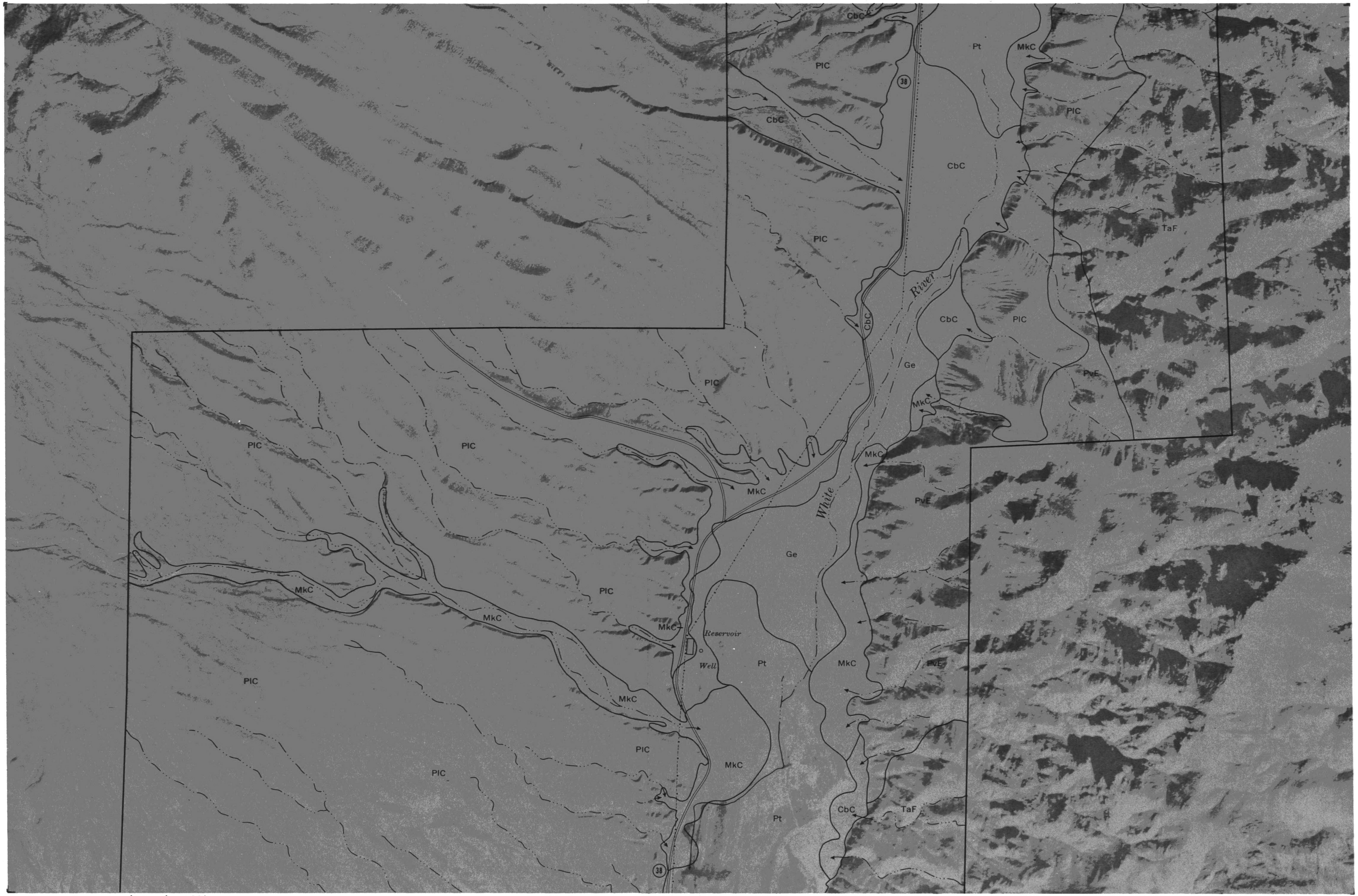
(Joins sheet 11)



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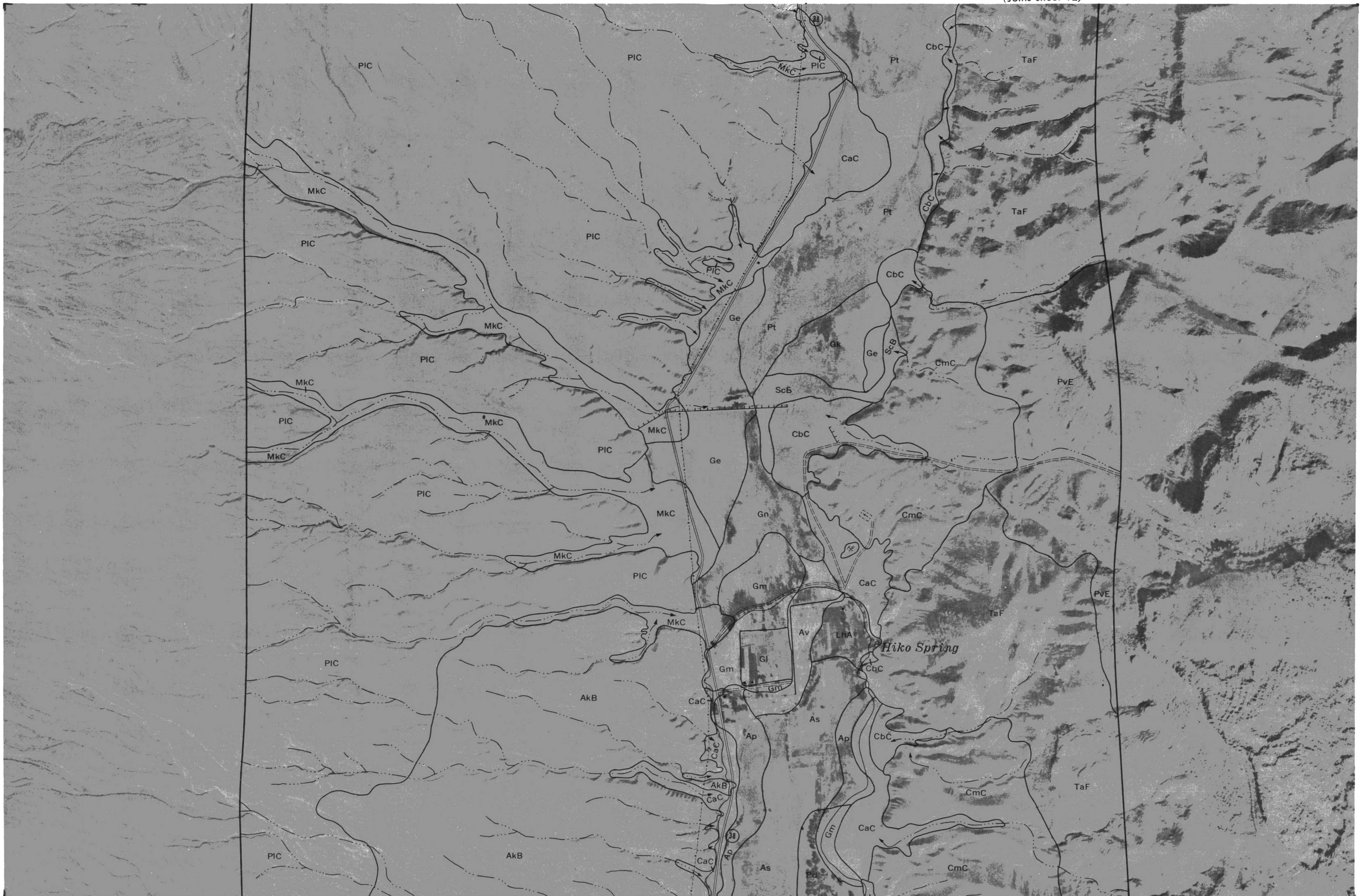
(13)

PAHRANAGAT-PENOYER AREAS, NEVADA NO. 13

(Joins sheet 12)



(Joins sheet 14)

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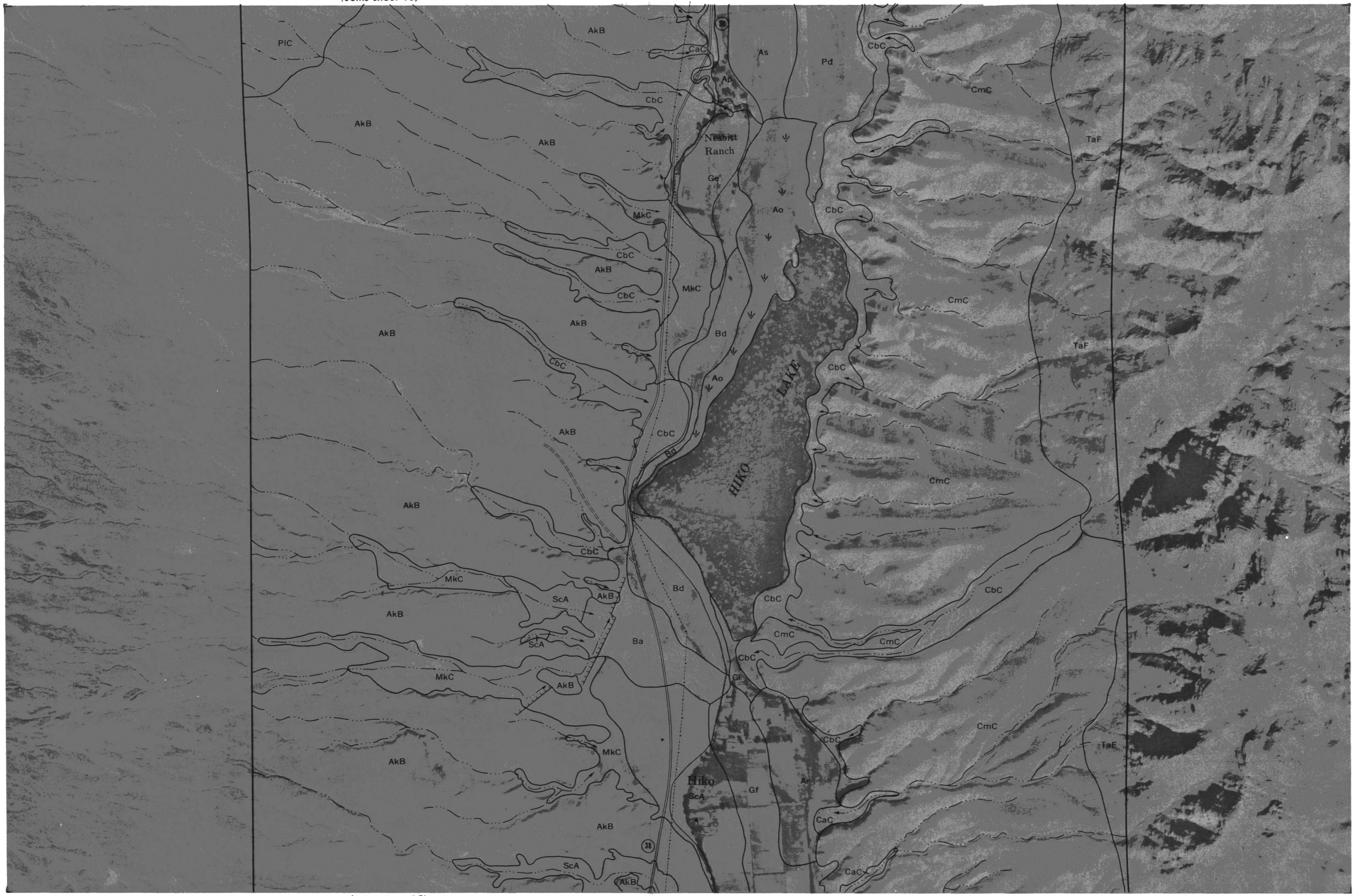
(14)

(Joins sheet 13)

N



(Joins sheet 15)

0 ½ 1 Mile Scale 1:15 840 0 5000 Feet

(15)

(Joins sheet 14)

PAHRANAGAT-PENOYER AREAS, NEVADA NO. 15

Scale 1:15 840

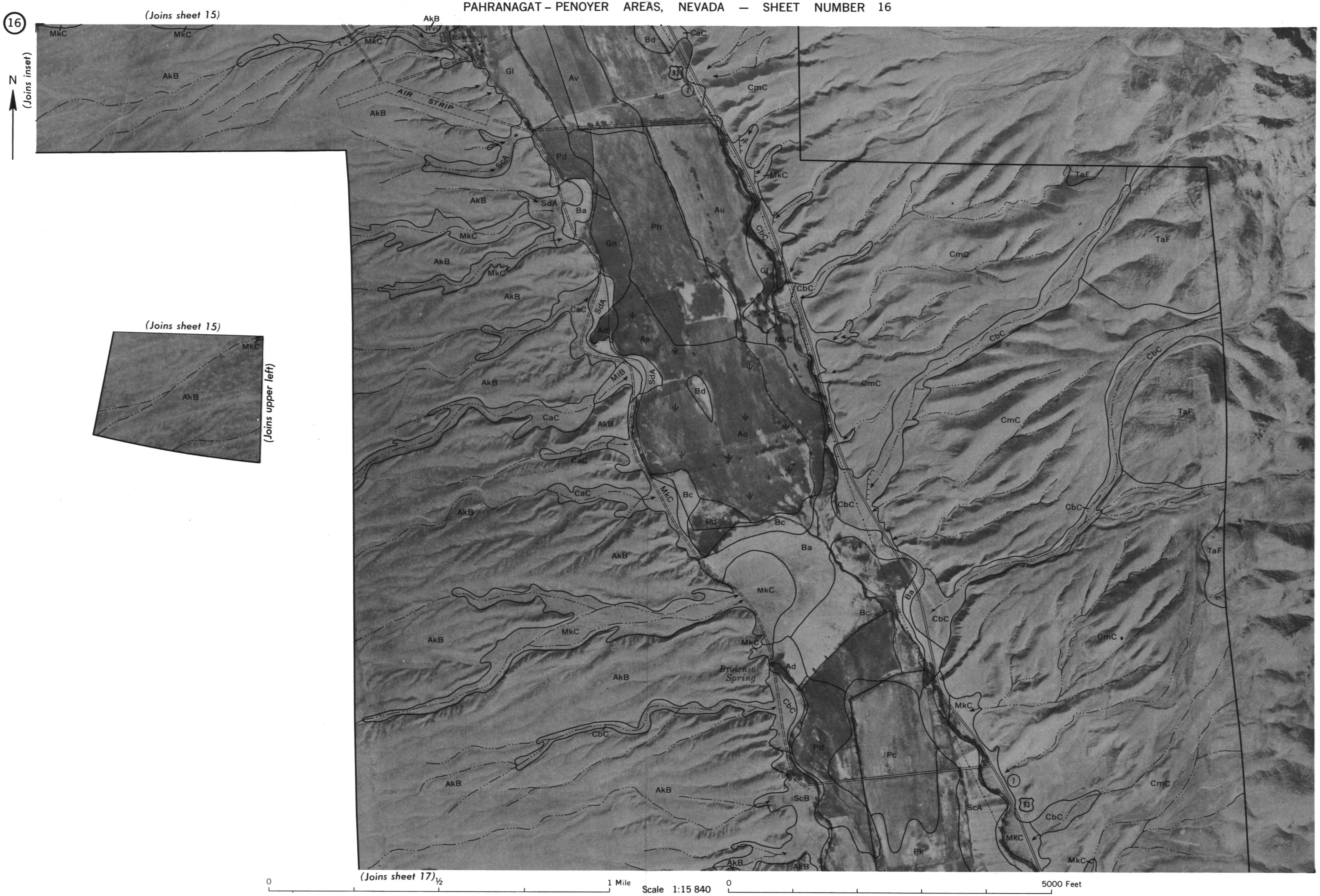
5000 Feet

1 Mile

½

0

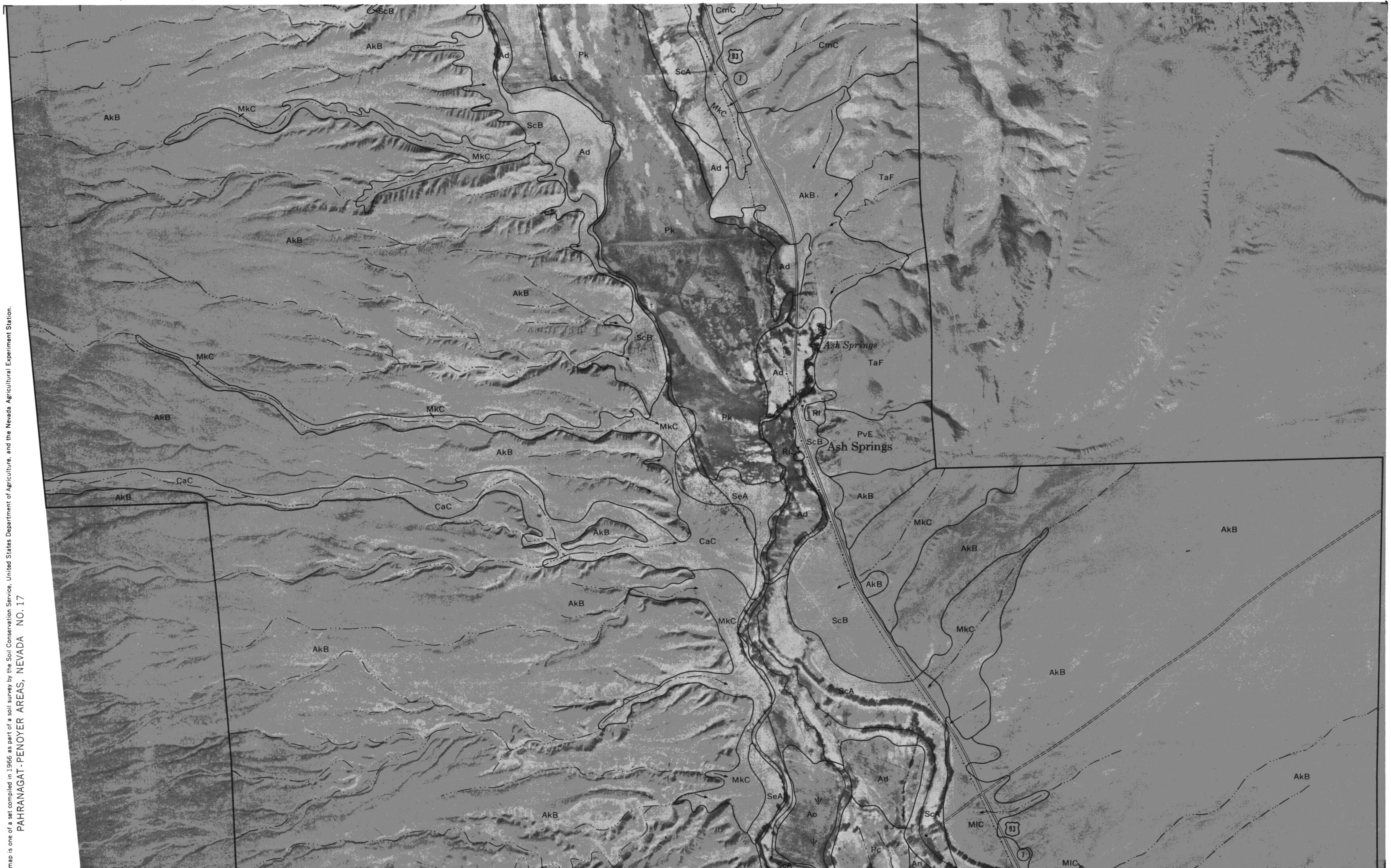
(Joins inset, sheet 16) | (Joins sheet 16)



PAHRANAGAT-PENOYER AREAS, NEVADA NO. 16

17

(Joins sheet 16)

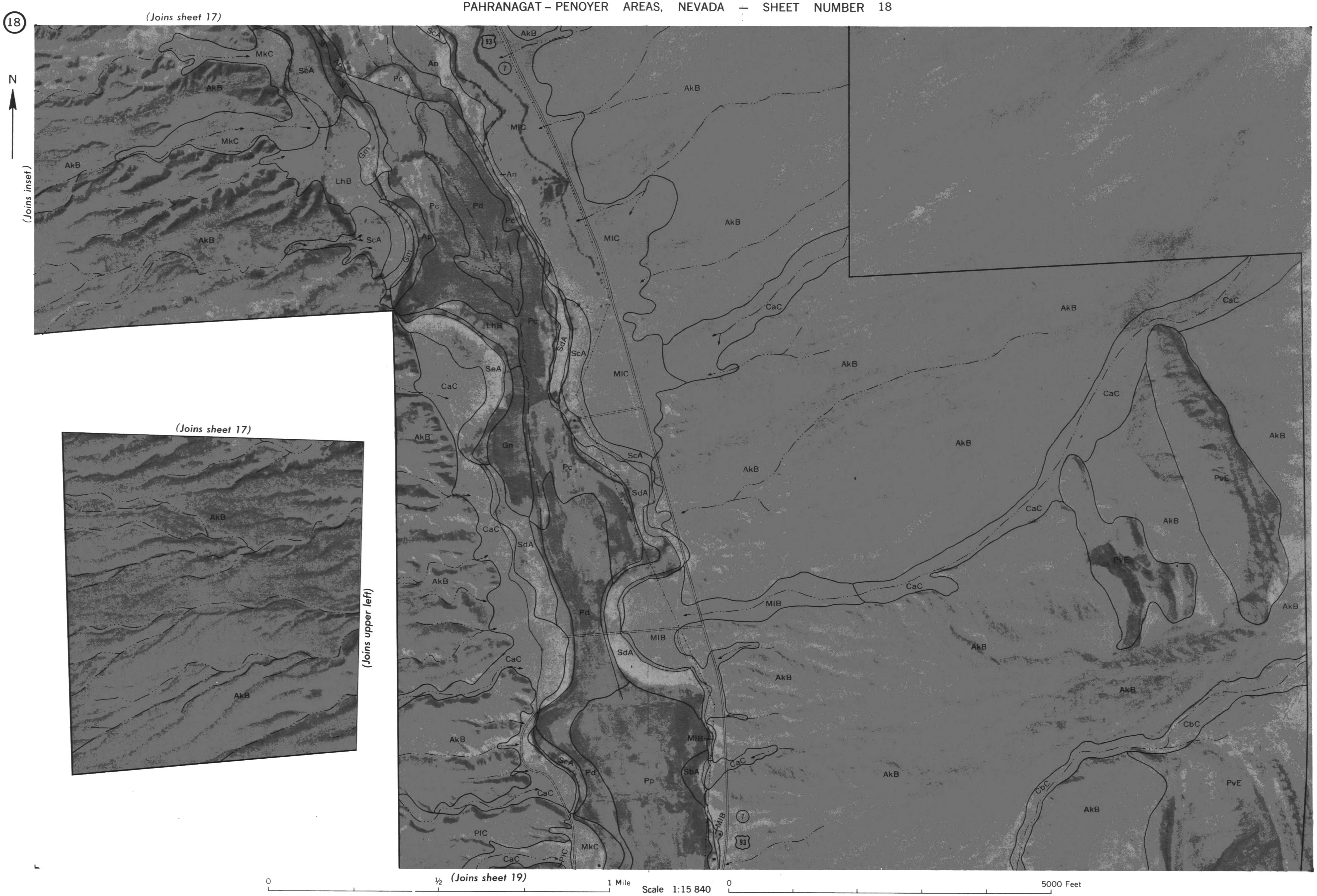


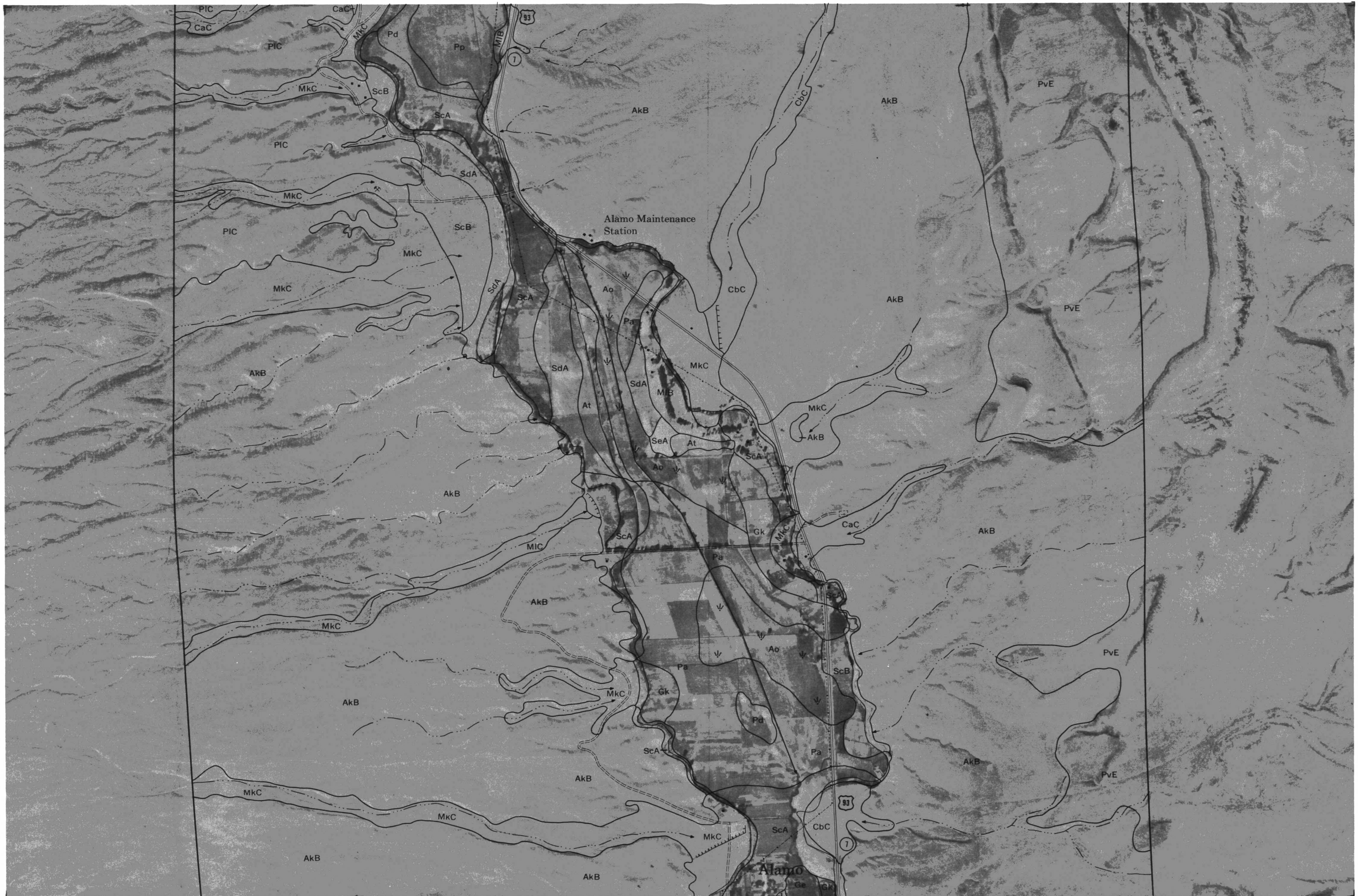
(Joins inset, sheet 18) | (Joins sheet 18)

0 1 Mile Scale 1:15 840 0 5000 Feet

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Nevada Agricultural Experiment Station.

PAHRANAGAT-PENOYER AREAS, NEVADA NO. 17


18
(Joins sheet 17)
N
(Joins inset)
(Joins sheet 17)
(Joins upper left)
(Joins sheet 19)
AkB
MkC
ScA
LhB
Gm
An
Pc
Pd
Ap
MlC
CaC
SeA
SdA
Gn
MlB
SbA
Pp
PlC
CbC
PvE
93
7
0
½
1 Mile
Scale 1:15 840
0
5000 Feet



(Joins sheet 20)

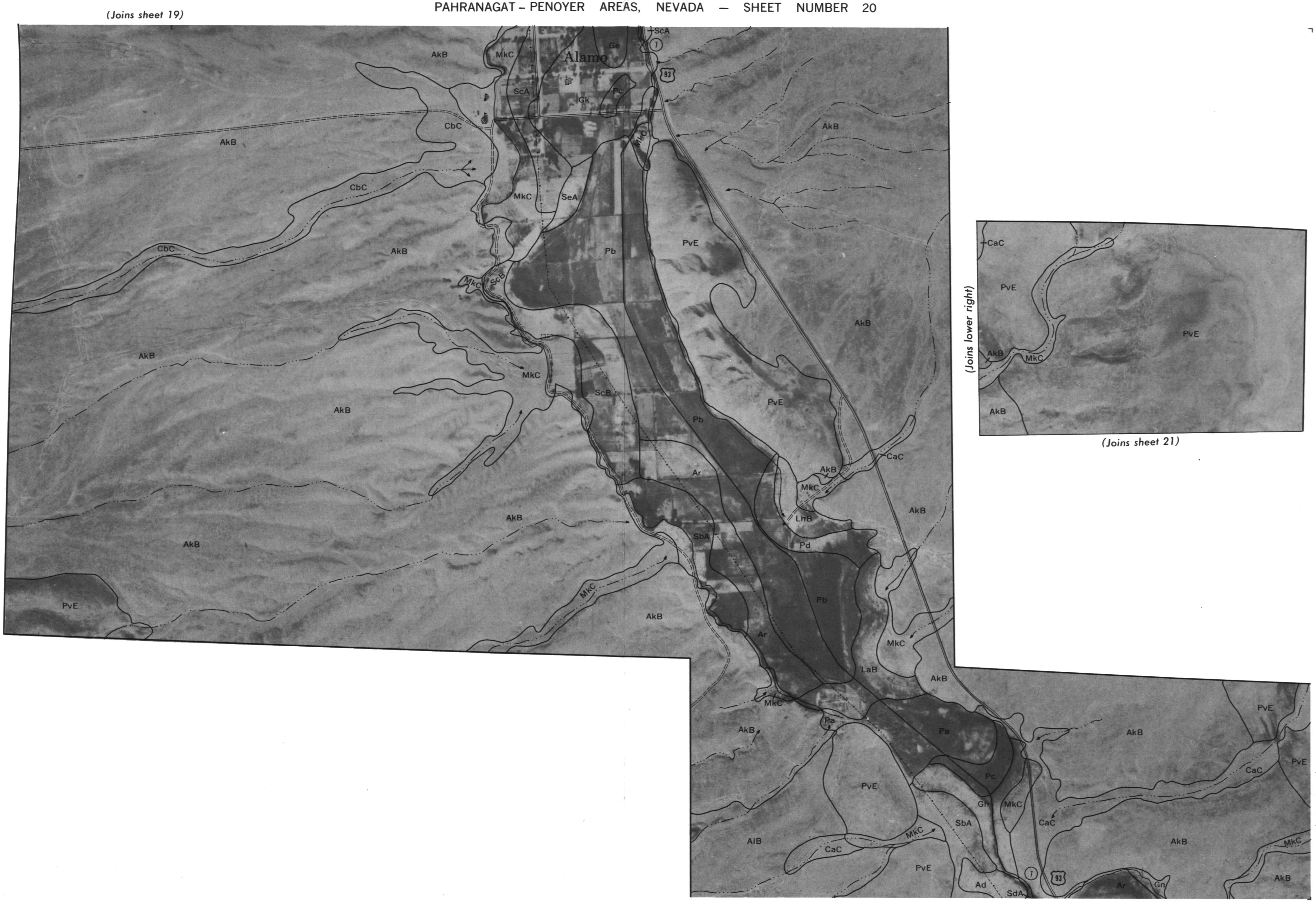
Scale 1:15 840

0 ½ 1 Mile

0 5000 Feet

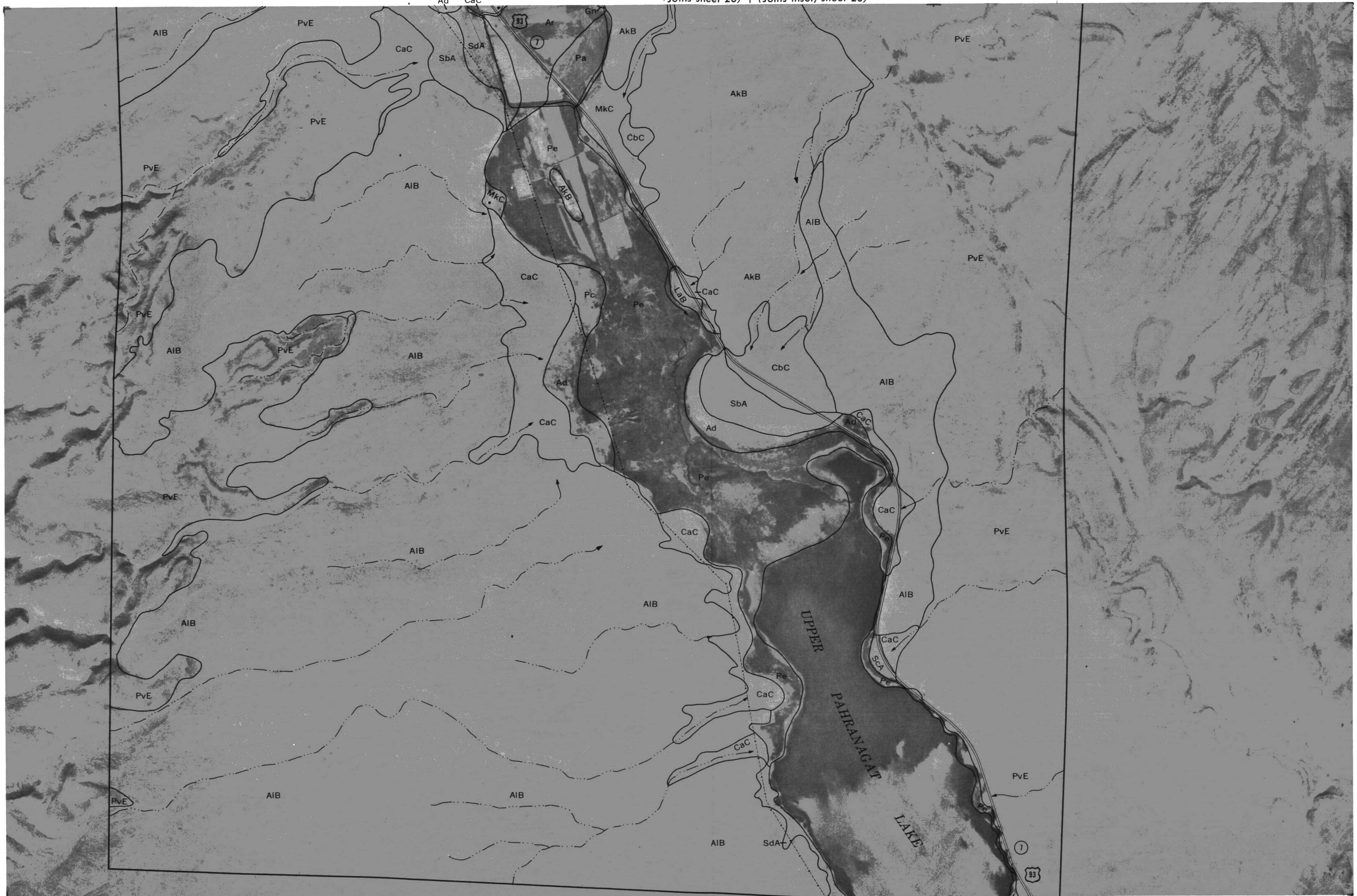
20

N



0 ½ 1 Mile Scale 1:15 840 0 5000 Feet

(Joins sheet 20) | (Joins inset, sheet 20)



(Joins sheet 22)

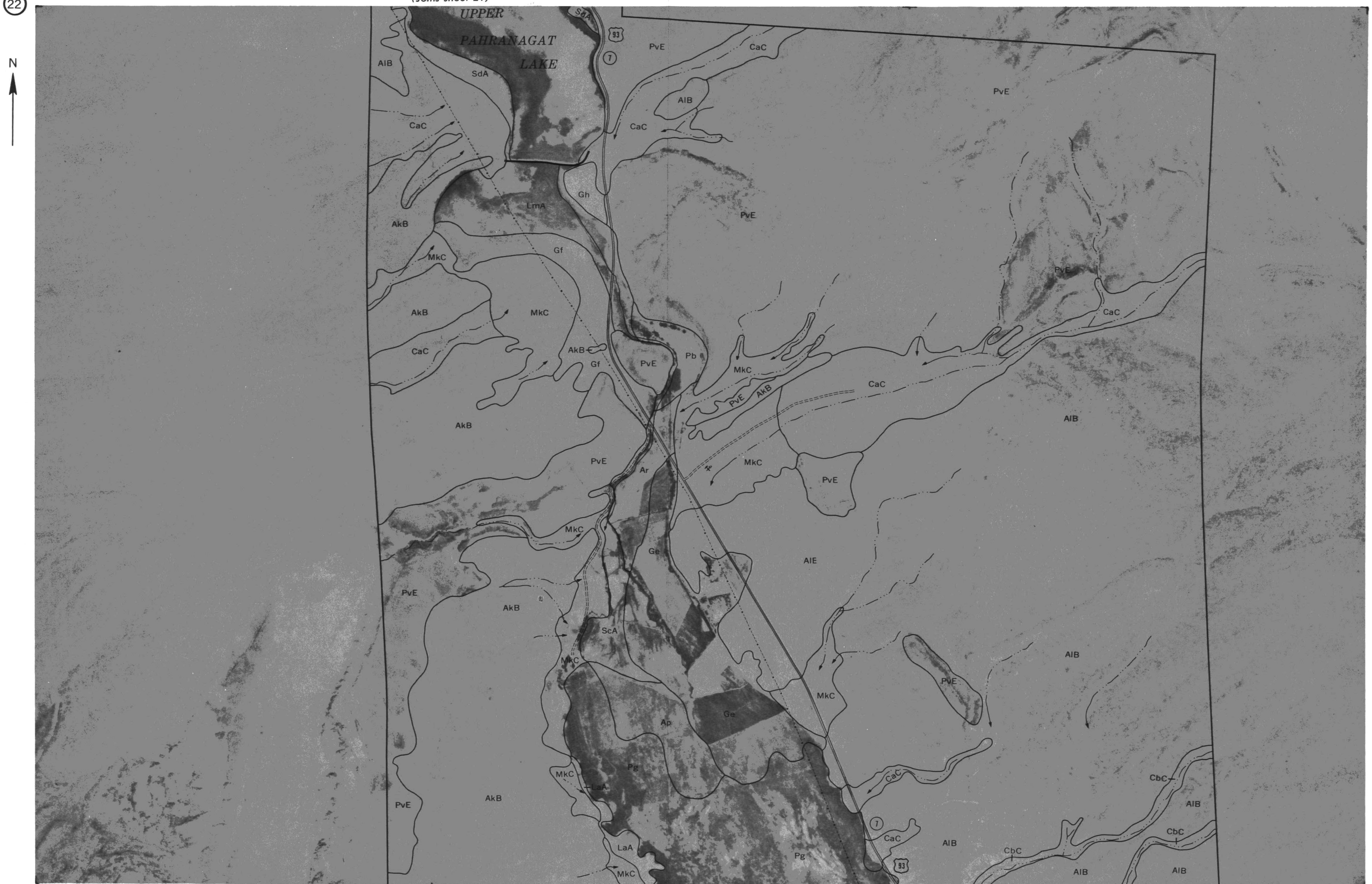
Scale 1:15 840

0 ½ 1 Mile

0 5000 Feet

PAHRANAGAT – PENOYER AREAS, NEVADA — SHEET NUMBER 22

(Joins sheet 21)



(Joins sheet 23)

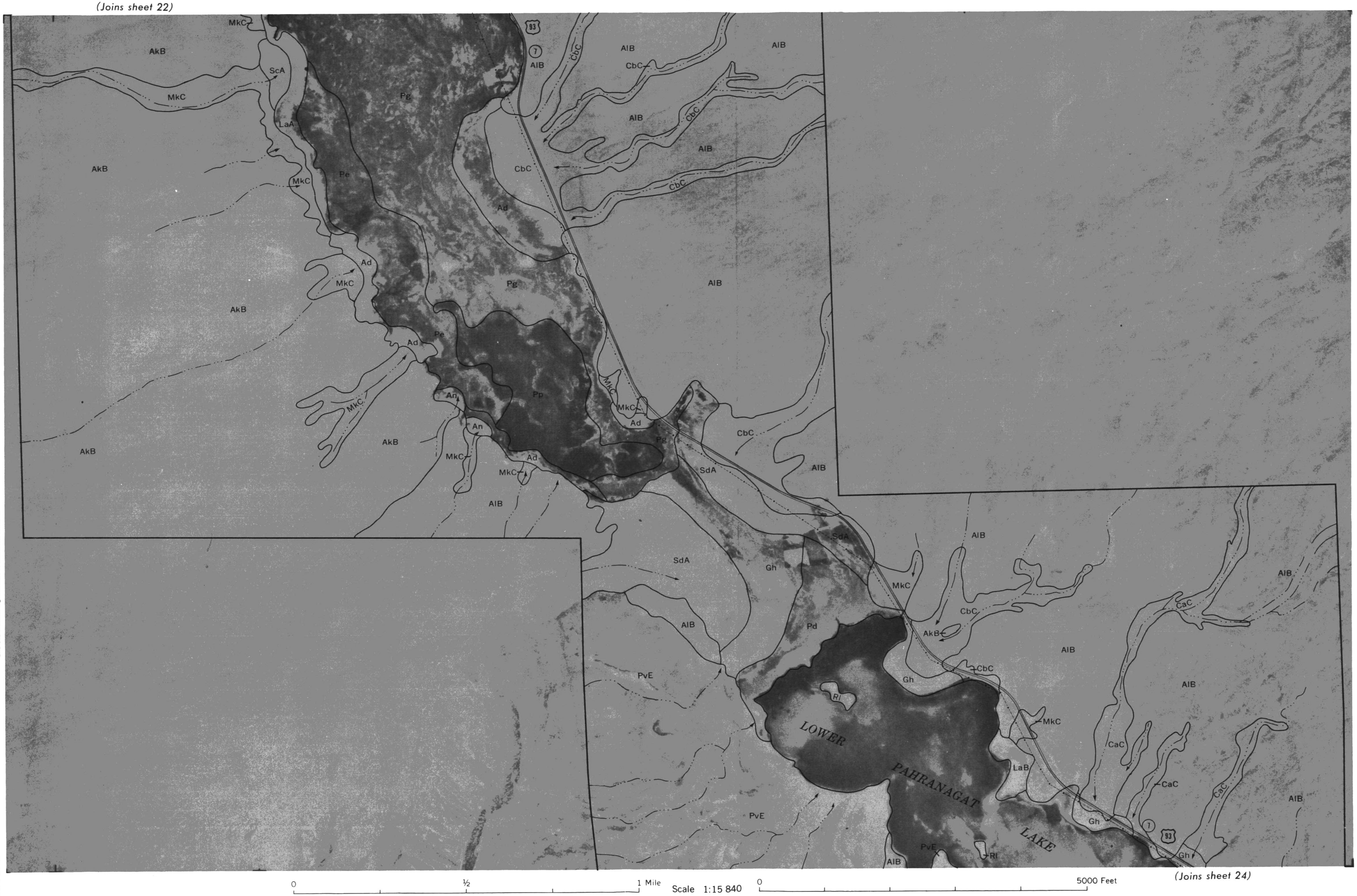
0 ½ 1 Mile

Scale 1:15 840

0 5000 Feet

(Joins sheet 22)

23



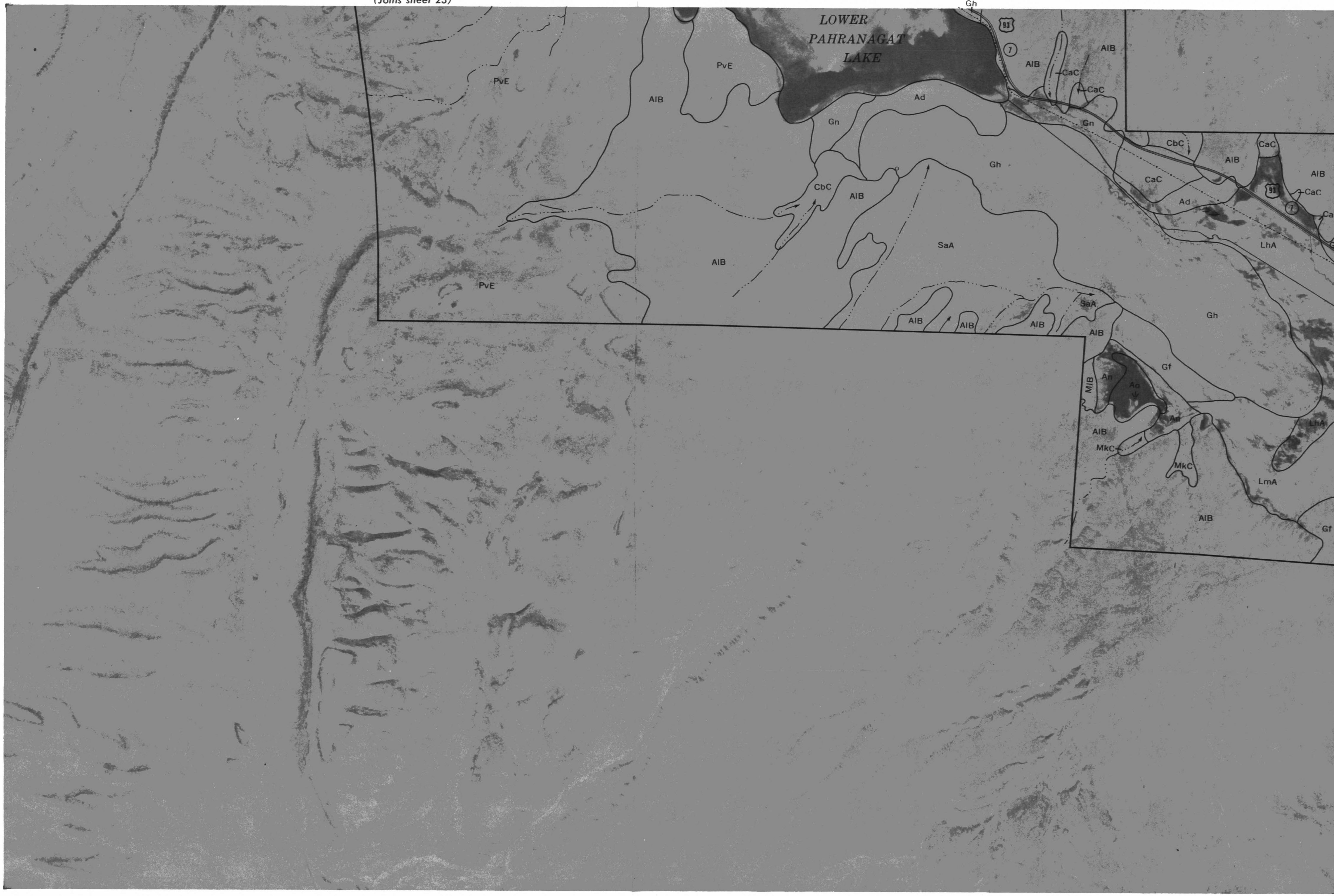
(Joins sheet 24)

This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Nevada Agricultural Experiment Station.

PAHRANAGAT – PENOYER AREAS, NEVADA — SHEET NUMBER 24

(Joins sheet 23)

N



0 ½ 1 Mile Scale 1:15 840 0 5000 Feet

25

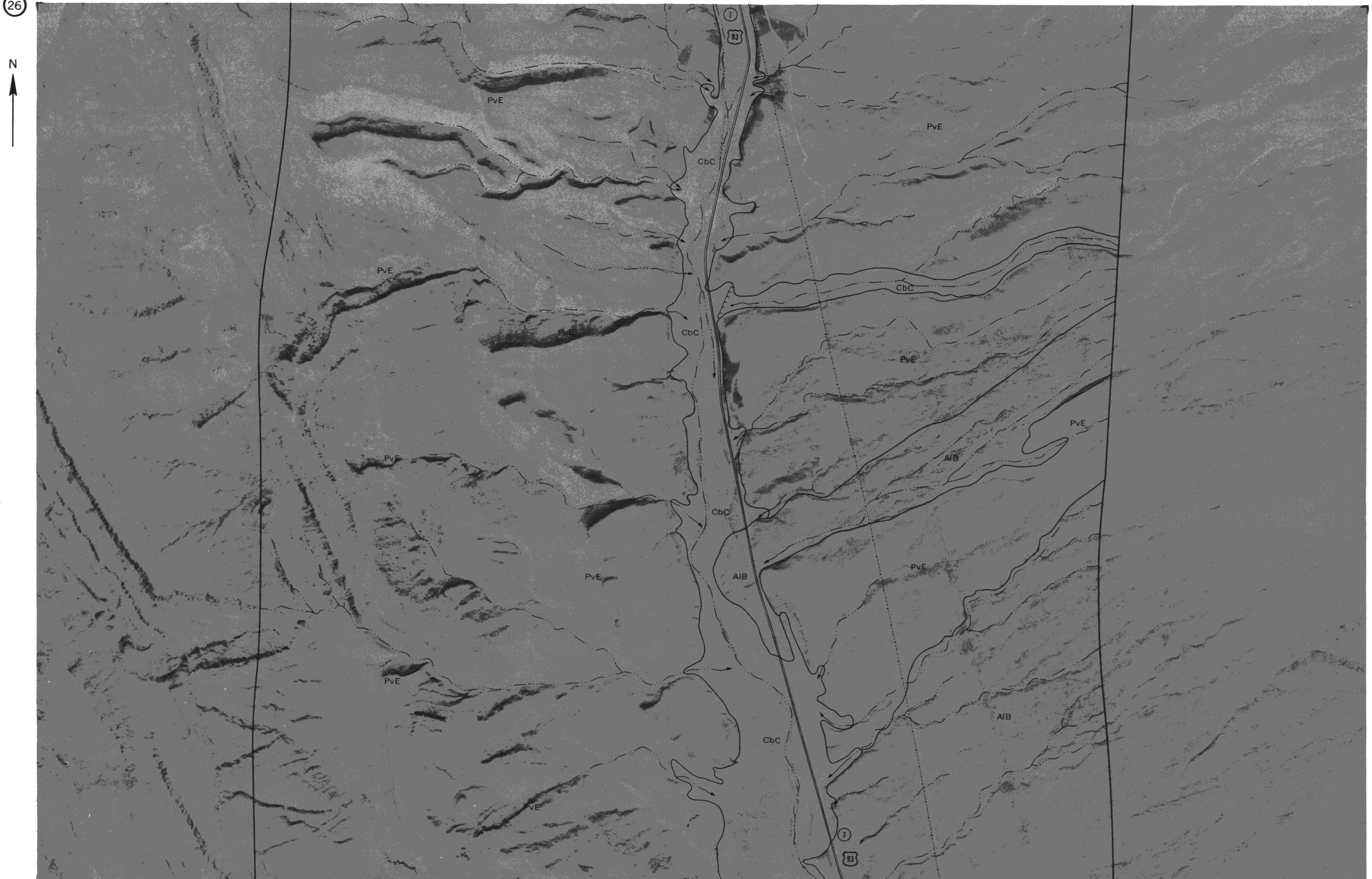
N

(Joins sheet 24)

0 ½ 1 Mile Scale 1:15 840 0 5000 Feet

(Joins sheet 26)

(Joins sheet 25)

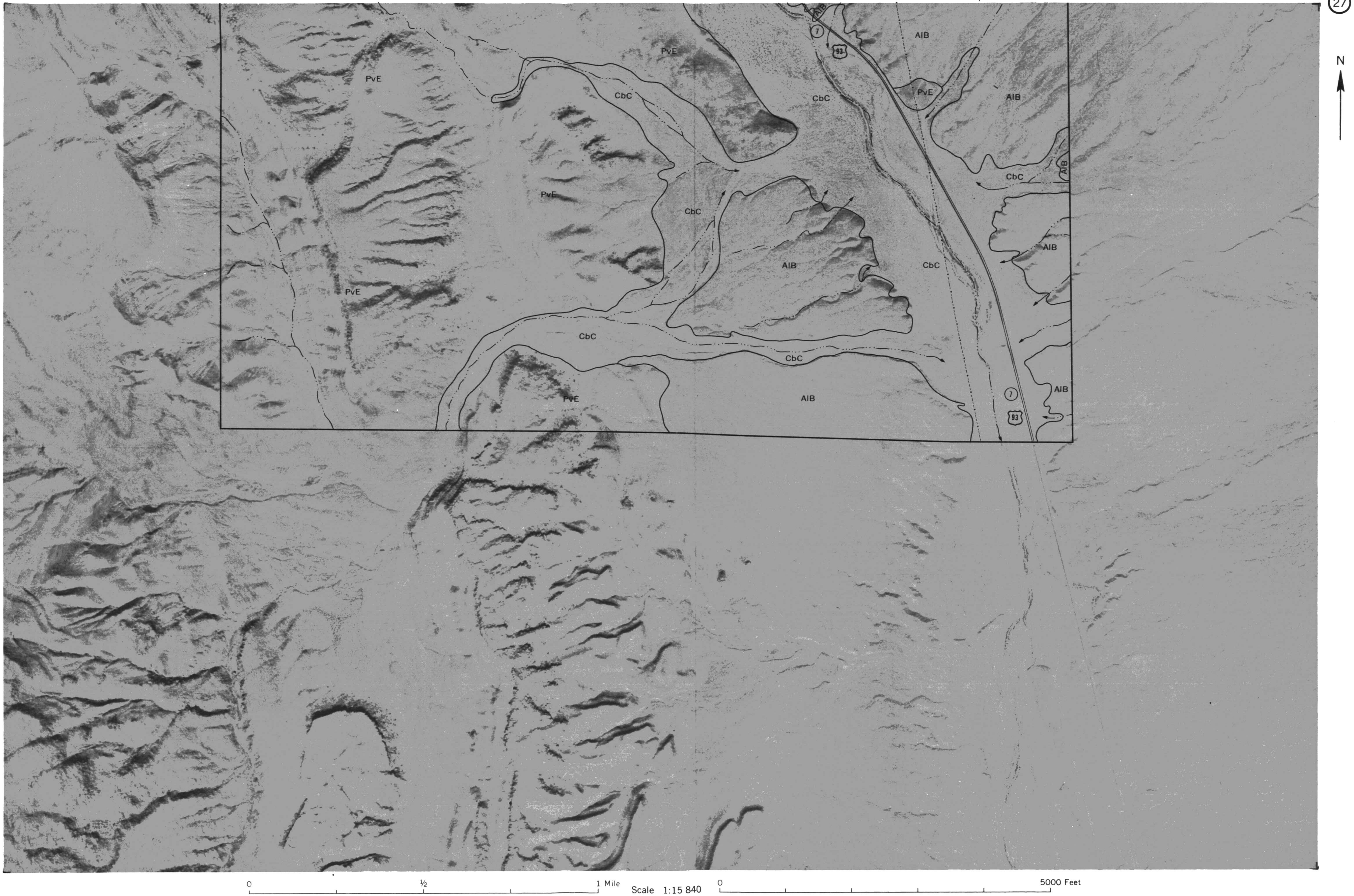


(Joins sheet 27)

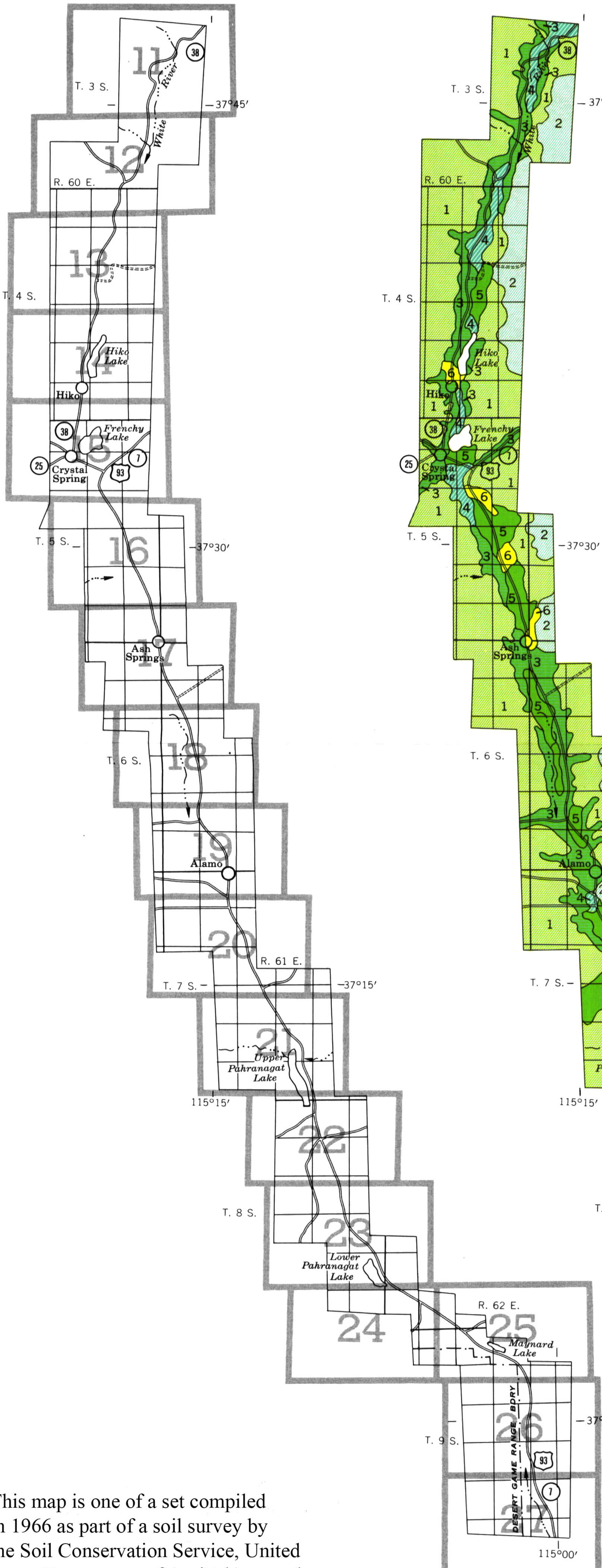
0 ½ 1 Mile Scale 1:15 840 0 5000 Feet

(Joins sheet 26)

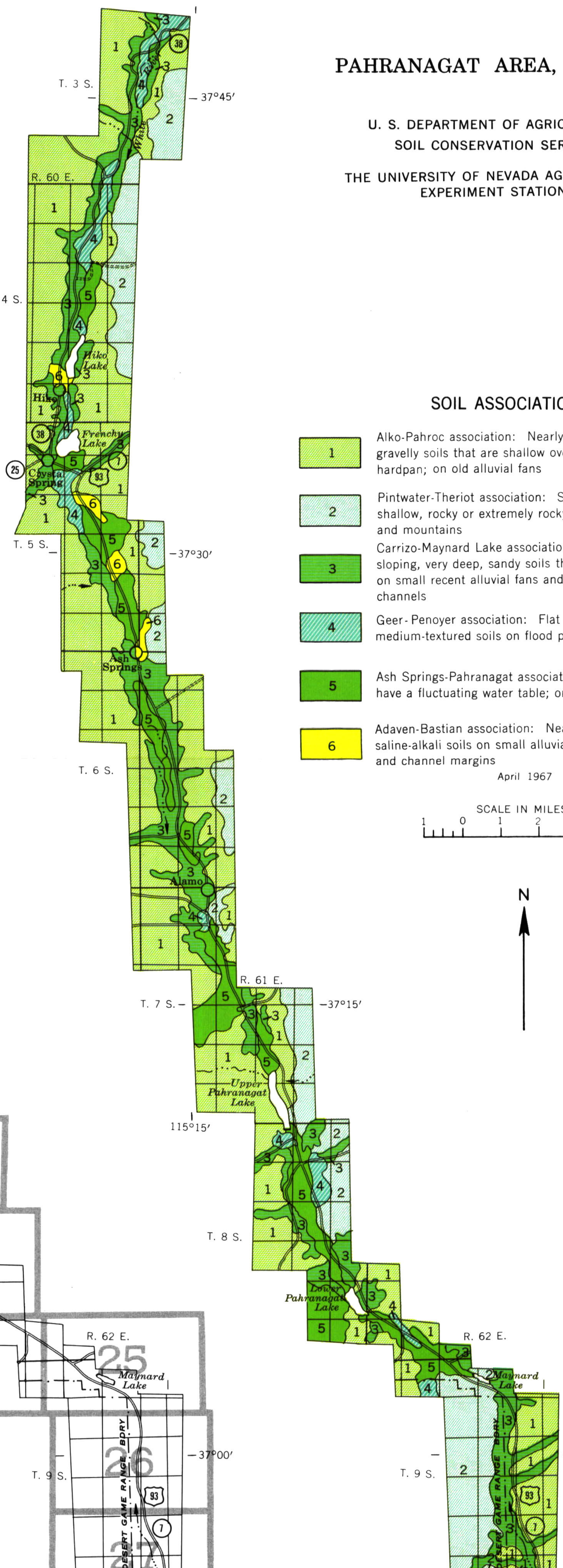
27



INDEX TO MAP SHEETS



GENERAL SOIL MAP



PAHRANAGAT AREA, NEVADA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

THE UNIVERSITY OF NEVADA AGRICULTURAL
EXPERIMENT STATION

SOIL ASSOCIATIONS

1 Alko-Pahroc association: Nearly level to moderately sloping, gravelly soils that are shallow over silica and lime cemented hardpan; on old alluvial fans

2 Pintwater-Theriot association: Sloping to very steep, shallow, rocky or extremely rocky soils on hills, ridges, and mountains

3 Carrizo-Maynard Lake association: Nearly level to strongly sloping, very deep, sandy soils that are gravelly or stony; on small recent alluvial fans and in intermittent stream channels

4 Geer-Penoyer association: Flat or nearly level, very deep, medium-textured soils on flood plains

5 Ash Springs-Pahranagat association: Nearly level soils that have a fluctuating water table; on flood plains

6 Adaven-Bastian association: Nearly level, medium-textured, saline-alkali soils on small alluvial fans and along lake and channel margins

April 1967

SCALE IN MILES

1 0 1 2 3 4

N

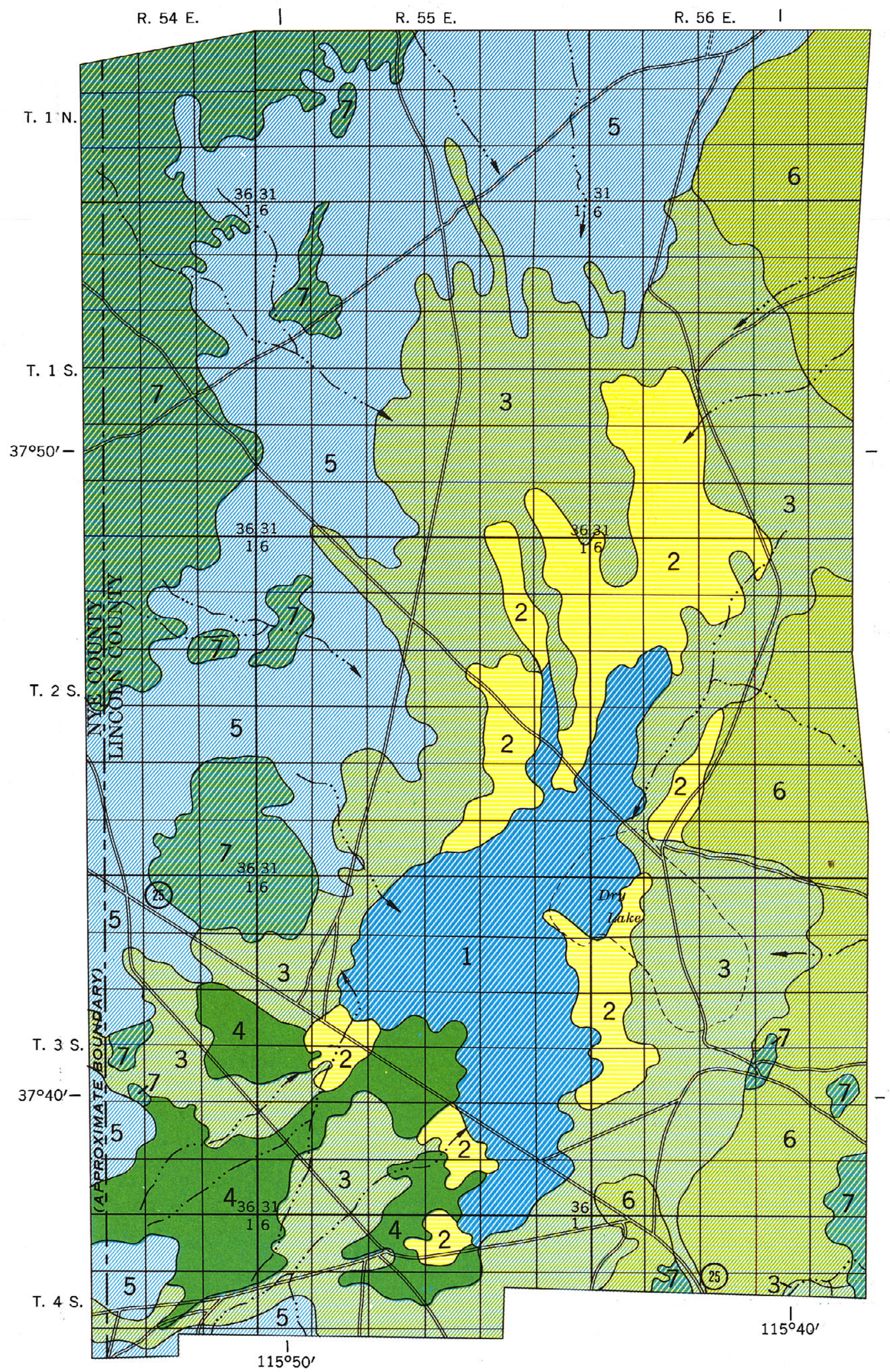
This map is one of a set compiled in 1966 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Nevada Agricultural Experiment Station.

PENOYER AREA, NEVADA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

THE UNIVERSITY OF NEVADA AGRICULTURAL
EXPERIMENT STATION

GENERAL SOIL MAP



SOIL ASSOCIATIONS

- 1 Playa-Jarboe-Kawich association: Flat wasteland; nearly level, fine-textured, saline and alkali soils; and coarse-textured soils on dunes
- 2 Monte Cristo-Penoyer association: Nearly level saline-alkali soils
- 3 Fang-Cliffdown association: Nearly level and gently sloping, moderately coarse textured and coarse textured soils on alluvial fans and flood plains
- 4 Papoose-Nyala association: Nearly level and gently sloping soils that have a loamy subsoil; on alluvial fans
- 5 Tickapoo-Timpahute association: Nearly level to strongly sloping soils that have a clayey subsoil
- 6 Silent-Sierocliff association: Gently sloping to strongly sloping, moderately deep and shallow, limy soils
- 7 Rock land-Silverbow association: Moderately sloping to extremely steep rocky areas and shallow soils

April 1967

SCALE IN MILES

1 0 1 2 3 4

N

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INDEX TO MAP SHEETS